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AN ANALYSIS OF MARKET INSPECTION REPORTS ON SPOILAGE OF CANTALOUPS AND RELATED MELONS

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AN ANALYSIS OF MARKET INSPECTION REPORTS

ON SPOILAGE OF CANTALOUPS[1/] AND RELATED MELONS

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1/ Although a strict taxonomic usage of the term "cantaloup" would limit it to members of *Cucumis melo* var. *cantalupensis* it has come to be generally used in the United States to designate the small green-skinned, netted muskmelons, *C. melo* var. *reticulatus*, and it is employed in the latter sense in this publication. "Muskmelon" is a group name used to designate all kinds of melons other than watermelons and includes cantaloup, Honey Dew, Honey Ball, Casaba, Persian, Spanish, and other related melons.

INTRODUCTION

Since 1931 the writer has been engaged in a study of the market diseases of fruits and vegetables at New York City. During the early years of the work considerable attention was given to the decays of cantaloups and related melons. The results of these studies have already been published.2/ More recently the market spoilage of melons has been approached by an entirely different method. Through the courtesy of the United States Agricultural Marketing Administration an opportunity has been afforded to examine food-products inspection certificates that have been issued for the inspection of melons. The present paper is therefore based on a study of nearly 10,000 inspections made at New York City during the years 1933, 1934, 1935, and 1941. There is also included a summary of nearly 4,000 inspections made at many different markets throughout the United States during the much earlier period of 1922-28, inclusive.3/

INSPECTIONS OF 1933, 1934, 1935, AND 1941

Methods. Fortunately for the purposes of this study, there had been organized during 1933 a group of produce receivers who arranged to have inspections made regularly on most of their cars at the time of unloading in New York City. A group of licensee inspectors gave full time to this work and the inspection certificates were filed separately. Since August, 1933, there has thus been available a set of certificates that includes condition reports on somewhat over half of the cars of cantaloups, Honey Dew, Honey Ball, and mixed melons received annually at New York from the 3 States of California, Colorado, and Arizona. The certificates examined and summarized for the years 1933, 1934, 1935, and 1941 were exclusively from this lot, and included all of the inspections made on melons of this type received during the period under consideration from these 3 States by the group of receivers noted above.

2/ Wiant, James S. Investigations of the market diseases of cantaloups and Honey Dew and Honey Ball melons. U. S. Dept. Agr. Techn. Bull. 573. 1937

3/ Reports of similar studies by others include the following:
Rose, D. H. Diseases of apples on the market. U.S. Dept. Agr. Bull. 1253. 1924
Rose, D. H. Diseases of strawberries on the market. U. S. Dept. Agr. Circ. 402. 1926
Stevens, N. E. Market diseases of strawberries from the southeastern States, 1926 to 1930. U. S. Dept. Agr. Circ. 219. 1932
Stevens, N. E. Spoilage of tomatoes in transit, as shown by inspection certificates, 1922 to 1930. U. S. Dept. Agr. Circ. 245. 1932
Brooks, C. Spoilage of stone fruits on the market. U. S. Dept. Agr. Circ. 253. 1933

For a high percentage of the inspections the distinguishing marks on the container labels were not sufficiently inclusive to enable the determination of the State of origin by the inspector. This was due to the fact that many western shippers pack melons in season from more than one of the 3 States involved. The same brand label is used throughout and frequently the only statement of location printed on it refers to the main office which may be in a different State from the one in which the melons were grown and packed. No attempt was made, therefore, to summarize the inspection records by States of origin.

Upon examination of the certificates it was found that in many instances the inspector had recorded more than one type of decay on a single certificate. For example, the certificate might read "....6 per cent decay. Decay is rhizopus and fusarium rots." During the tabulation of the inspection data the amount of decay occurring in the various combinations of rots was recorded separately. However, in preparing the summary tables it appeared that the distribution of the several rots could best be shown if the combinations of decay were broken down into their component rots. The following method was therefore adopted: Where the different rots appeared in combination it was assumed that on the average each was of equal importance as a factor of spoilage. Thus if 24 carlots were found to show an average of 6% total decay consisting of rhizopus and fusarium rots, 24 half-carlots were listed as affected with 6% rhizopus rot and 24 half-carlots with 6% fusarium rot. If the carlot total for a given combination of rots was an odd number, the decay cited first in the combination as it appeared on the certificate was listed alone in one carlot, thus avoiding fractions in totals of carlots. Combinations of 3 different decays were handled similarly.

Although having the advantage of showing the average spoilage per car in terms of the specific rots responsible, the method does not reveal the complete distribution of a given rot throughout the entire number of carlots in which it occurred in combination with other decays. The complete distribution is therefore presented in full in the text.

Where both surface mold and decay occurred in a given carlot the inspector recorded separately the percentage affected with each. If a given melon was affected with both mold and decay it was scored only under decay (the more serious of the two defects). Total spoilage can thus be determined by adding the percentage affected with mold to the percentage affected with decay.

Results -- Cantaloups. Results from 3294 carlot inspections of cantaloups are summarized in Table 1 by type of decay and mold.

The inspections for 1933 were begun in August so that the 389 carlots for that year represented only 18% of the total New York City receipts[4] from California, Arizona, and Colorado.

4/ Reports issued in mimeographed form by the United States Agricultural Marketing Service show that a total of 7982 carlots of cantaloups from Arizona, California, and Colorado were unloaded at New York City during

Table 1.
Decay and Mold in Carlots of Cantaloups -- 1933, 1934, 1935 and 1941
(Table continued on facing page)

YEAR	TOTAL NUMBER OF CAR-LOTS IN-SPEC-TED	CARLOTS WITH DECAY									
		Alternaria Rot		Cladosporium Rot		Fusarium Rot		Phytophthora Rot		Rhizopus Rot	
		Number of carlots	Average per-centage of Decay	Number of carlots	Average per-centage of Decay	Number of carlots	Average per-centage of Decay	Number of carlots	Average per-centage of Decay	Number of carlots	Average per-centage of Decay
1933	389	57	9.1	--	--	21	12.5	--	--	72	6.4
1934	1053	127	7.7	--	--	121	5.8	--	--	39	4.4
1935	827	76	4.1	--	--	28	4.4	--	--	49	5.6
1941	1025	--	--	51	10.2	225	4.8	6	7.8	347	3.9
Total or Aver-age	3294	260	6.9	51	10.2	395	5.5	6	7.8	507	4.4

Those inspected during 1934, 1935, and 1941 comprised approximately half of the cantaloups received from the 3 States during those years.

Rhizopus rot and alternaria rot were nearly equally of first importance in 1933. The former occurred in a somewhat greater number of carlots but

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4/ the 4 years 1933, 1934, 1935, and 1941. These represented approximately 58% of total cantaloup unloads from all States.

Honey Dew melons during the same period totalled 7605 carlots from the 3 States. These comprised practically all of the domestic Honey Dew unloads at New York City.

Mixed carlots of melons and carlots of Honey Ball melons unloaded at New York from the 3 States totalled 3816, nearly 70% of which were Honey Balls. These constituted practically all of the mixed carlots and approximately 87% of all Honey Ball melons that were unloaded at New York City during this period.

The melons found in mixed carlots were chiefly either cantaloups, Honey Dews, or Honey Balls, although other types of muskmelons such as Persian melons and Casaba melons were also shipped in mixed carlots along with the other 3 types.

Of all cantaloups from California, Arizona, and Colorado that were unloaded at New York City during the 4 years, 71% were from California, 17% from Arizona, and 12% from Colorado. Similarly with Honey Dew melons, 83% were from California, 10% from Colorado, and 7% from Arizona. Practically all Honey Ball melons and carlots of mixed melons were from California.

Table 1 conc.
Decay and Mold in Carlots of Cantaloups -- 1933, 1934, 1935 and 1941

YEAR	TOTAL NUMBER OF CARLOTS INSPECTED	CARLOTS WITH DECAY: Unclassified: Number of carlots	CARLOTS WITH DECAY: Unclassified: Average percentage of decay	CARLOTS WITH MOLD: Mold not associated with decay: Number of carlots	CARLOTS WITH MOLD: Mold not associated with decay: Average percentage of mold	CARLOTS WITH MOLD: Mold associated with decay: Number of carlots a/	CARLOTS WITH MOLD: Mold associated with decay: Average percentage of mold	TOTAL OF DECAY AND MOLD: Number of carlots b/	TOTAL OF DECAY AND MOLD: Average percentage of decay and mold
1933	389	24	10.4	82	10.9	54	15.7	256	12.6
1934	1053	19	7.3	106	10.2	221	19.8	412	18.0
1935	827	--	--	137	5.5	149	10.7	290	10.6
1941	1025	18	2.3	50	6.5	347	14.1	697	11.8
Total: or Average	3294	61	7.0	375	8.1	771	15.2	1655	13.3

a/ Total number of carlots in which both mold and decay occurred.
b/ Does not include the number of carlots listed under "mold associated with decay."

the average incidence of decay was lower than in those affected with alternaria rot. Fusarium rot was found in the fewest of the carlots having decay although the percentage per carlot was the highest.

Alternaria rot, followed closely by fusarium rot, was the most important decay in 1934. Rhizopus rot was the least so of the 3 decays.

Again in 1935 alternaria rot was responsible for more decay than was any other rot. Rhizopus rot was next in importance and fusarium rot was the least prevalent of the 3.

Over 1/3 of the carlots inspected in 1941 averaged 3.9% decay from rhizopus rot. Nearly 1/4 averaged 4.8% decay from fusarium rot. Alternaria rot was not reported. Cladosporium rot, which was not reported during 1933-35, was found in a number of carlots in 1941. Phytophthora rot, likewise not reported during 1933-35, was recorded for 6 carlots.

On the basis of a 4-year average the order of prevalence was rhizopus rot, fusarium rot, alternaria rot, cladosporium rot, and phytophthora rot. Decay per car, caused by each of these individual organisms, averaged for the 4 years, ranges from 4.4 to 10.2%.

During the 4 years 667 carlots were noted in which combinations of either 2 or 3 different rots were found associated in the same carlot. By including in the computation the occurrence of each kind of rot either alone or

in association with others, it was found that of the 1280 total carlots in which decay was present rhizopus rot occurred in 49%, fusarium rot in 39%, alternaria rot in 5%, cladosporium rot in 7%, and phytophthora rot in 1%.

Carlots in which mold alone was reported varied in number from 50 in 1941 to 137 in 1935 and totalled 375 carlots for the 4 years. These represented approximately 11% of all carlots. An average of 8.1% of the cantaloups in them were affected with mold.

The number of carlots in which mold was found associated with decay varied from 54 in 1933 to 347 in 1941 and totalled 771 or nearly 1/4 of the carlots inspected during the 4 years. The extent to which it occurred was 15.7% of the cantaloups in the cars of 1933, 19.8% in those of 1934, 10.7% in 1935 and 14.1% in 1941, with an average of 15.2% for the 4 years.

The average percentage of cantaloups affected with mold and with decay respectively has been computed on the basis of both total carlots showing either defect and of total carlots inspected. This is summarized in Table 2. During each year the number with mold or decay constituted a considerable part of the total number inspected with an average for the 4 years of slightly over 1/2 the carlots so affected. In these affected cars, 4.3% of the melons were affected with decay and 9.0% with mold. Expressed in another way, 2.2% of all cantaloups inspected were decayed and an additional 4.5% were moldy, a total of 6.7% for the 2 defects.

Results -- Honey Dew Melons. A total of 4181 carlots of Honey Dew melons were inspected. The results are summarized in Table 3 by types of decay and mold. The 800 carlots of 1933 constituted approximately 46% of the total New York City receipts of domestic Honey Dews[5]. During each of the other 3 years the percentage was even higher so that for the 4 years as a whole approximately 55% of the domestic Honey Dews received at this market were inspected.

During 1933 and 1934 rhizopus rot was the most important decay found. Alternaria rot was next in importance. Fusarium rot was reported in much fewer carlots than were the other 2 decays.

Rhizopus rot and alternaria rot were the most important decays in 1935. The former occurred in more cars than the latter but affected fewer melons per car. Phytophthora rot, not reported in the inspections of 1933 and 1934, was of next importance, followed by cladosporium rot, likewise not reported during the 2 preceeding years. A few cars were found affected with fusarium rot.

In 1941 the several decays occurred in the following order of decreasing importance - rhizopus rot, cladosporium rot, fusarium rot, phytophthora rot, and alternaria rot. Of chief interest was the small amount of alternaria rot and the large amount of cladosporium rot together with the increasing importance of fusarium rot.

The order of prevalence for the 4-year total was rhizopus rot, alternaria rot, cladosporium rot, fusarium rot, and phytophthora rot. Decay per car caused by each of these individual organisms, averaged for the 4 years,

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5/ See Footnote 4.

Table 2.
Summary of decay and mold in carlots of Cantaloups, Honey Dew, Honey Ball and Mixed Melons -- 1933, 1934, 1935 and 1941

YEAR AND TYPE OF MELON	TOTAL CARLOTS INSPECTED: NUMBER	TOTAL CARLOTS INSPECTED: Decay: Average percentage of melons affected per car	TOTAL CARLOTS INSPECTED: Mold: Average percentage of melons affected per car	TOTAL CARLOTS INSPECTED: Total of Decay and mold: Average percentage of melons affected per car	CARLOTS WITH DECAY OR MOLD: NUMBER	CARLOTS WITH DECAY OR MOLD: Decay: Average percentage of melons affected per car	CARLOTS WITH DECAY OR MOLD: Mold: Average percentage of melons affected per car	CARLOTS WITH DECAY OR MOLD: Total of Decay and mold: Average percentage of melons affected per car	CARLOTS WITH NO DECAY OR MOLD
Cantaloup									
1933	389	3.8	4.5	8.3	256	5.8	6.8	12.6	133
1934	1053	1.9	5.2	7.1	412	4.8	13.2	18.0	641
1935	827	0.8	2.9	3.7	290	2.5	8.1	10.6	537
1941	1025	2.9	5.1	8.0	697	4.3	7.5	11.8	328
Total or average for Cantaloup	3294	2.2	4.5	6.7	1655	4.3	9.0	13.3	1639
Honey Dew Melon									
1933	800	3.8	0.2	4.0	422	7.2	0.4	7.6	378
1934	1124	1.2	0.2	1.4	303	4.7	0.4	5.1	821
1935	1335	1.2	0.3	1.5	391	4.2	0.9	5.1	944
1941	922	2.8	Trace	2.8	612	4.3	Trace	4.3	310
Total or average for Honey Dew Melon	4181	2.1	0.2	2.3	1728	5.0	0.4	5.4	2453
Honey Ball & mixed melons									
1933	283	4.5	3.0	7.5	159	8.0	5.3	13.3	124
1934	768	2.0	3.1	5.1	340	4.4	7.0	11.4	428
1935	748	1.1	1.3	2.4	267	3.0	3.7	6.7	481
1941 Mixed melons	271	0.8	1.0	1.8	127	1.8	2.0	3.8	144
1941 Honey Balls	345	3.2	2.7	5.9	124	8.9	7.5	16.4	221
Total or average for Honey Ball and Mixed melons	2415	2.1	2.2	4.3	1017	4.8	5.3	10.1	1398
Total or average all Years for all Melons	9890	2.1	2.1	4.2	4400	4.7	4.8	9.5	5490

Table 3.
Decay and Mold in carlots of Honey Dew Melons -- 1933, 1934, 1935 and 1941
(Table continued on facing page)

YEAR	TOTAL Number OF CAR-LOTS IN-SPEC-TED	CARLOTS WITH DECAY									
		Alternaria Rot		Cladosporium Rot		Fusarium Rot		Phytophthora Rot		Rhizopus Rot	
		Number of carlots	Average percentage of Decay	Number of carlots	Average percentage of Decay	Number of carlots	Average percentage of Decay	Number of carlots	Average percentage of Decay	Number of carlots	Average percentage of Decay
1933	800	110	8.7	--	--	17	13.7	--	--	246	6.9
1934	1124	110	6.5	--	--	34	3.3	--	--	140	4.0
1935	1335	105	5.4	21	8.1	10	4.8	58	3.9	174	3.7
1941	922	2	5.5	172	5.9	63	6.9	12	3.8	343	3.2
Total or Average	4181	327	6.9	193	6.1	124	6.6	70	3.9	903	4.4

Table 4.
Decay and Mold in Carlots of Honey Ball Melons and Mixed Melons -- 1933, 1934, 1935 and 1941
(Table continued on facing page)

1933	283	34	11.1	--	--	17	13.5	--	--	75	6.9
1934	768	81	7.0	--	--	63	3.8	--	--	138	4.8
1935	748	85	2.9	3	4.3	14	5.1	3	4.3	102	3.3
1941 Mixed melons											
	271	--	--	20	4.3	30	1.7	--	--	69	1.3
1941 Honey Ball											
	345	--	--	49	11.6	3	2.3	--	--	64	8.2
Total or Average	2415	200	5.9	72	9.2	127	4.7	3	4.3	448	4.8

ranges from 3.9 to 6.9%.

Combinations of either 2 or 3 different rots found associated in the same carlot were recorded from a total of 804 carlots during the 4 years. Computed on the basis of occurrence either alone or in combination with other rots it was determined that for all 1666 carlots in which decay was present, rhizopus rot was found in 64%, alternaria rot in 25%, cladosporium rot in 17%, fusarium rot in 11%, and phytophthora rot in 6%.

Mold was of much less importance in Honey Dew melons than in cantaloups. For the 4 years as a whole 62 carlots were noted in which mold occurred as

Table 3 conc.
Decay and Mold in carlots of Honey Dew Melons -- 1933, 1934, 1935 and 1941

YEAR	TOTAL NUMBER OF CAR-LOTS IN-SPEC-TED	CARLOTS WITH DECAY: Unclassified: Number of carlots	CARLOTS WITH DECAY: Unclassified: Average percentage of decay	CARLOTS WITH MOLD: Mold not associated with decay: Number of carlots	CARLOTS WITH MOLD: Mold not associated with decay: Average percentage of mold	CARLOTS WITH MOLD: Mold associated with decay: Number of carlots a/	CARLOTS WITH MOLD: Mold associated with decay: Average percentage of mold	TOTAL OF DECAY AND MOLD: Number of carlots b/	TOTAL OF DECAY AND MOLD: Average percentage of decay and mold
1933	800	24	5.9	25	4.9	11	6.7	422	7.6
1934	1124	6	5.2	13	4.8	8	8.4	303	5.1
1935	1335	--	--	23	6.5	33	6.1	391	5.1
1941	922	19	1.2	1	3.0	2	4.5	612	4.3
Total or Average	4181	49	4.0	62	5.5	54	6.5	1728	5.4

Table 4 conc.
Decay and Mold in Carlots of Honey Ball Melons and Mixed Melons -- 1933, 1934, 1935 and 1941

YEAR	TOTAL NUMBER OF CARLOTS INSPECTED	Unclassified: Number of carlots	Unclassified: Average percentage of decay	Mold not associated with decay: Number of carlots	Mold not associated with decay: Average percentage of mold	Mold associated with decay: Number of carlots a/	Mold associated with decay: Average percentage of mold	Total: Number of carlots b/	Total: Average percentage of decay and mold
1933	283	19	7.7	14	8.8	49	14.7	159	13.3
1934	768	7	4.9	51	9.0	139	13.8	340	11.4
1935	748	--	--	60	4.6	101	7.1	267	6.7
1941 Mixed melons	271	--	--	8	5.6	27	7.6	127	3.8
1941 Honey Ball	345	--	--	8	5.1	66	13.5	124	16.4
Total or Average	2415	26	7.0	141	6.7	382	11.6	1017	10.1

a/ Total number of carlots in which both mold and decay occurred.
b/ Does not include the number of carlots listed under "mold associated with decay."

the only defect, with an average of 5.5% of the melons affected.

Mold was found associated with decay in a total of 54 carlots. The extent to which it occurred was 6.7% of the melons in 1933, 8.4% in 1934, 6.1% in 1935 and 4.5% in 1941 with an average of 6.5% for the 4 years.

The comparatively slight importance of mold in the carlots of Honey Dew

melons inspected is further shown by the data in Table 2. Computed on the basis of all carlots affected, total decay amounted to an average of 5.0% of the melons. On the basis of all carlots inspected there was a 2.1% spoilage from decay while only 0.2% were affected with mold.

Results -- Honey Ball and Mixed Melons. A summary of inspections made on 2415 carlots of Honey Ball melons and mixed melons is found in Table 4. Only for 1941 are the data in the table recorded separately for Honey Balls.

The inspections of 1933 covered approximately 32% of total New York City receipts[6] of Honey Ball and mixed melons while during each of the other years an average of approximately 73% were inspected.

During each of the first 3 years rhizopus rot was the most important decay present, alternaria rot was second in importance, and fusarium rot was the least prevalent of the 3 decays. Cladosporium rot and phytophthora rot were each recorded from 3 cars in 1935.

Rhizopus rot was the most important decay in mixed carlots of 1941. Fusarium rot and cladosporium rot were of nearly equal importance; the former was found in a greater number of carlots but the percentage of melons affected per car was considerably lower than in those affected with cladosporium rot. Considered on this basis, the latter was of approximately equal importance with rhizopus rot.

In the carlots of Honey Ball melons inspected during 1941, rhizopus rot was more prevalent than cladosporium rot but the percentage affected per car was lower. The 2 were of nearly equal importance. Fusarium rot was noted in 3 carlots.

For the entire period as a whole rhizopus rot was first and alternaria rot second in importance. Fusarium rot (more carlots but less decay per carlot) and cladosporium rot (greater decay per carlot but fewer carlots) followed with about equal importance. Phytophthora rot was of least importance. Decay per car caused by each of these individual organisms, averaged for the 4 years, ranges from 4.3 to 9.2%.

Different rots were found together in each of 206 carlots during the 4 years. Basing the computation on the presence of a given decay either alone or in association with another rot, it was determined that for all 876 carlots in which decay was present, rhizopus rot occurred in 61%, alternaria rot in 30%, fusarium rot in 18%, cladosporium rot in 11%, and phytophthora rot in less than 1%.

The number of carlots in which mold occurred alone (in Honey Ball and mixed melons combined) ranged in number from 14 in 1933 to 60 in 1935 and totalled 141 or 5.8% of all carlots for the 4 years. From 4.6 to 9.0% of the melons were affected per carlot with an average of 6.7% for the 4 years.

The number of carlots in which mold was found associated with decay (in Honey Ball and mixed melons combined) varied from 49 in 1933 to 139 in 1934 and totalled 382 or 15.8% of the carlots inspected during the 4 years. The extent to which it so occurred was 14.7% of the melons in 1933, 13.8% in 1934, 7.1% in 1935, 7.6% mixed melons in 1941 and 13.5% of Honey Ball melons in 1941.

6/ See Footnote 4.

The average percentage of melons affected with mold and with decay respectively is summarized in Table 2. Decay was a greater spoilage factor than mold during 1933 and (in Honey Ball melons) during 1941. For the 4 years as a whole spoilage was noted in somewhat less than half of the 2415 carlots. In these carlots 4.8% were affected with decay and 5.3% with mold. Expressed in another way 2.1% of Honey Ball and mixed melons combined were affected with decay and 2.2% with mold, a total of 4.3% for the 2 years.

INSPECTIONS OF 1922-28, INCLUSIVE

Methods. The information obtained from the melon inspections of 1922-28, inclusive, was secured from a set of abstracts that had previously been prepared for several commodities by members of the Bureau of Plant Industry and that were based upon certificates filed in Washington by the Agricultural Marketing Administration. The abstracts were believed to cover practically all receiving-point inspections of cantaloups and Honey Dew melons made throughout the United States during the period under discussion.

Throughout the course of these earlier inspections few references were made to the occurrence of mold. Only decay, therefore, has been listed in the summary tables.

Results -- Cantaloups. The data presented in Tables 5 and 6 summarize 3380 cantaloup inspections. Approximately one-half of the carlots originated in California and 84% in the 6 States of Arizona, Arkansas, California, Colorado, New Mexico, and Texas.7/

Of all 3380 inspections, 748 were made at Cleveland, 342 at New York City, 211 at St. Louis, 190 at Pittsburg, 185 at Chicago, 127 at Boston, 107 at New Orleans, and 102 at Philadelphia. The remaining 1368 inspections were made at 47 different markets, only 12 of which were represented by more than 50 carlots apiece. This distribution does not parallel that of total cantaloup unloads, for according to mimeographed reports by the Agricultural Marketing Service, New York City unloads were regularly much greater than those of any other market, whereas Chicago, Philadelphia, Pittsburg, Cleveland, Detroit, and St. Louis in the order named followed New York City in number of all muskmelon unloads.

From the data in Table 5, it will be noted that less than half of the total decay has been recorded under specific rots. Of these fusarium rot was consistently of greatest importance and occurred in approximately two and one-half times as many carlots as did all other specifically-named rots combined. Cladosporium rot was next in importance. Bacterial

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7/ According to mimeographed reports issued by the Agricultural Marketing Service, shipments of all types of muskmelons (most of which were cantaloups) from all states totalled nearly 200,000 carloads for the period of 1922-28, inclusive. Cantaloups inspected at receiving-point cities thus represented 1.7% of total muskmelon shipments.

Table 5.
Decay in carlots of cantaloups, 1922-28, inclusive

YEAR	TOTAL NUMBER OF CARLOTS INSPECTED	CARLOTS WITH DECAY: Alternaria Rot		Bacterial Soft Rot		Cladosporium Rot		Fusarium Rot		Rhizopus Rot		Unclassified and mixed decays		TOTAL OF ALL DECAYS	
		Number of carlots	Average per-centage of decay	Number of carlots	Average per-centage of decay	Number of carlots	Average per-centage of decay	Number of carlots	Average per-centage of decay	Number of carlots	Average per-centage of decay	Number of carlots	Average per-centage of decay	Number of carlots	Average per-centage of decay
1922	385	6	13.8	7	19.3	6	17.8	27	11.5	--	--	52	14.8	98	14.4
1923	321	3	5.3	1	50.0	5	18.4	37	6.2	--	--	40	10.0	86	9.2
1924	471	1	trace	--	--	2	47.5	19	4.9	5	4.4	28	8.4	55	8.1
1925	590	5	trace	15	10.7	7	24.9	43	7.1	3	21.0	55	13.1	128	11.1
1926	593	5	6.2	--	--	4	3.8	29	8.1	--	--	57	10.1	95	9.0
1927	729	4	9.0	--	--	--	--	23	11.3	--	--	58	5.6	85	7.3
1928	291	1	2.0	--	--	3	9.0	32	12.4	--	--	28	5.0	64	8.8
Total or Average	3380	25	6.7	23	15.0	27	18.9	210	8.7	8	10.6	318	9.9	611	10.0

soft rot was recorded during 3 seasons, in large amount in 1925. Although found in fewer carlots than alternaria rot the percentage affected per car was much higher. Rhizopus rot was noted during 2 seasons.

A summary of total decay arranged by States where the cantaloups originated is presented in Table 6. In general, the smaller the number of carlots inspected, the greater was the proportion of those affected with decay. The amount of decay per car was high in the carlots from all States with the exception of Colorado and Arizona. For the 7-year period as a whole, decay was noted in somewhat less than 1/5 of the carlots with an average of 10% of the melons affected per carlot. Expressed in terms of total melons inspected 1.8% were affected with decay.

Results -- Honey Dew Melons. The results of 574 inspections of Honey Dew melons are summarized in Tables 6 and 7. On the basis of mimeographed reports issued by the Agricultural Marketing Service it is estimated that these represented between 1.5 and 2% of all carlots shipped during the period.

Of all 574 inspections, 211 were made at Cleveland, 77 at Chicago, 36 at New York City, 25 at St. Louis, 22 at New Orleans, and 21 at Boston. The remaining 182 were made at 27 other markets, only 8 of which were represented by 15 or more carlots apiece. As with cantaloups the geographical distribution of carlots inspected does not parallel that of total unloads.

From Table 7 it will be noted that of the 3 specific decays for which data are presented, fusarium rot was the most prevalent, followed in order by order by alternaria rot and anthracnose rot. The percentage affected per car was lowest for fusarium rot. Approximately two-thirds of the carlots with decay are listed under unclassified and mixed decays.

The summary in the second section of Table 6 shows that the percentage of decay in the carlots affected was high from all States, although those from California showed the lowest amount. Decay was present to the amount of 12.5% in these carlots, and on the basis of all 574 carlots an average of 5.8% of the melons were affected.

DISCUSSION

This study of melon inspection certificates begun in 1933 was discontinued after 1935. When the work was taken up later it appeared more desirable to include the inspections of a more recent year than to continue with those of 1936.

With the exception that cladosporium rot and phytophthora rot were not reported before 1935 and that alternaria rot was unreported in 1941, the same decays were found prevalent during the 4 years. Their relative importance was much the same for all types of melons included in the study.

Combining the data in Tables 1, 3, and 4, it will be seen that decay occurred in 3822 carlots or 38.6% of the total inspected. The average incidence of decay per carlot in those affected with rhizopus rot was 4.5%, in those with fusarium rot 5.5%, in those with phytophthora rot 5.7%, in those with alternaria rot 6.7%, in those with cladosporium rot

Table 6.
Summary of decay in carlots of Cantaloups and Honey Dew melons, 1922-28, inclusive

STATE OF ORIGIN	TOTAL CARLOTS INSPECTED		CARLOTS WITH DECAY		CARLOTS WITH NO DECAY
	Number	Average Percentage of decay	Number	Average Percentage of decay	Number
Cantaloups					
Arizona	385	0.3	44	3.0	341
Arkansas	203	1.6	32	10.4	171
California	1750	0.9	212	7.4	1538
Colorado	292	1.7	55	0.9	240
Delaware	35	10.3	30	12.0	5
Georgia	26	18.5	20	24.1	6
Illinois	94	4.3	34	11.8	60
Indiana	77	3.1	27	8.8	50
Maryland	31	8.2	18	14.2	13
New Mexico	37	3.1	12	9.7	25
North Carolina	24	11.5	19	14.5	5
Ohio	95	2.1	18	11.0	77
Texas	151	1.3	24	7.9	127
Other States or unrecorded	177	5.9	66	15.9	111
Total or Average	3380	1.8	611	10.0	2769
Honey Dew Melons					
Arizona	68	4.8	28	11.7	40
California	268	3.2	109	8.0	159
Colorado	149	9.3	94	14.8	55
Other States or unrecorded	89	8.6	37	20.6	52
Total or Average	574	5.8	268	12.5	306

7.5%, and in those with unclassified decay 5.9%. Considering both the number of carlots and the percentage of decay per carlot it was determined that rhizopus rot was responsible for approximately 40% of the total decay that was found in the 3822 carlots, alternaria rot for 25%, fusarium rot for 17%, cladosporium rot for 12%, phytophthora rot for 2%, and undetermined rots for 4%.

As already pointed out several different rots were in many instances found associated in the same carlot. Taking into consideration, then, the occurrence either alone or in association with other rots, of the total 3822 carlots in which decay was present, rhizopus rot was found in 60%, alternaria rot in 26%, fusarium rot in 22%, cladosporium rot in 12%, phytophthora rot in 3%, and unclassified rots in 3% of the carlots.

Table 7.
Decay in carlots of Honey Dew melons, 1922-28, inclusive

YEAR	TOTAL NUMBER OF CARLOTS INSPECTED	CARLOTS WITH DECAY								TOTAL OF ALL DECAYS	
		Alternaria Rot		Anthracnose Rot		Fusarium Rot		Unclassified and mixed decays			
		Number of carlots	Average percentage of decay	Number of carlots	Average percentage of decay	Number of carlots	Average percentage of decay	Number of carlots	Average percentage of decay	Number of carlots	Average percentage of decay
1922	22	3	1.7	--	--	2	1.0	5	9.6	10	5.5
1923	14	--	--	3	37.3	1	10.0	8	37.5	12	35.2
1924	48	--	--	1	40.0	2	43.5	11	8.6	14	15.8
1925	63	7	3.3	--	--	2	2.5	15	15.1	24	10.6
1926	139	11	25.4	1	28.0	5	5.0	62	10.4	79	12.1
1927	191	8	22.3	7	9.7	12	9.9	50	11.4	77	12.1
1928	97	6	22.5	--	--	14	5.6	32	8.9	52	9.6
Total or Average	574	35	17.1	12	20.7	38	8.6	183	11.9	268	12.5

Mold was found associated with decay in a total of 1207 carlots (12.2% of total carlots inspected) with an average of 13.7% of the melons affected. Nearly three-fourths of the total mold associated with decay occurred in the carlots of cantaloups; very little was found in the carlots of Honey Dew melons inspected.

Mold occurred alone in a total of 578 carlots with an average of 7.5% of the melons affected per carlot. Here again nearly three-fourths of the mold was in carlots of cantaloups while those of Honey Dew melons had very little.

Either mold, or decay, or both, were found in 4400 carlots or 44.5% of the total 9890 carlots inspected (Table 2). In these 4400 carlots, 4.7% of the melons were affected with decay and 4.8% with mold, or a total of 9.5%. Considered in another way 2.1% of all melons inspected were affected with decay and 2.1% with mold, or 4.2% total for both defects.

The presence of mold or decay on a melon does not necessarily indicate that the melon is unfit for food. Much depends of course upon the number of areas affected and their size, in other words the extent to which the melon is damaged. Mold of course is much less important than decay in that it is confined to the surface and in fact constitutes little more than a blemish. This is particularly true where it occurs only to a slight extent and where it is found at the stem scar. In such cases it can readily be removed with the hand. Much of the mold reported was of this nature. Decay, even when found affecting only a small portion of the melon, is a much more serious defect. The presence of decay at the time of unloading indicates the likelihood of further spoilage before the melons reach the consumer.

Although the kind of mold observed was not reported on the certificates, the writer found on the New York market that during the years covered by this study cladosporium mold was by far the most important.

The identity of the fungi responsible for decay is not given in the inspection reports, although the genera to which they belong is readily apparent from the common names used for the decays both on the certificates and in the present publication. Information on the species ordinarily involved may be found in the writer's summary of melon decays already referred to [8].

The writer, although in no way responsible for the work of the inspectors, was in close contact with them during the period of 1933 to 1941 inclusive, and from time to time observed much of the inspection activities at the melon-unloading piers.

The inspections of 1922-28, as pointed out above, were of an entirely different nature and are not directly comparable to those of 1933-35 and 1941. By combining the totals for both cantaloups and Honey Dew melons (Table 6) it was determined that decay occurred in 879, or 22.2% of all carlots inspected, with an average of 10.7% of the melons affected per carlot; and on the basis of all carlots inspected decay averaged 2.4%.

8/ See Footnote 3.

SUMMARY

An analysis was made of the information on mold and decay reported in 9890 carlots of melons that were inspected at New York City during 1933, 1934, 1935 and 1941. These included 3294 carlots of cantaloups, 4181 of Honey Dew melons, and 2415 of Honey Ball and mixed melons combined. All originated in Arizona, California, or Colorado and together constituted approximately one-half of the melons that were unloaded at New York City from those States during the 4 years.

A summary of the different kinds of decay and mold has been presented in tabular form by years for each type of melon.

Specific decays cited on the inspection reports were, in order of their relative importance, rhizopus rot, alternaria rot, fusarium rot, cladosporium rot, and phytophthora rot.

Decays or molds, or both, were found in 4400 carlots. An average of 4.7% of the melons in these cars were affected with decay and 4.8% with mold. Expressed in terms of all 9890 carlots, 2.1% of all melons inspected were affected with decay and 2.1% with mold, or 4.2% total spoilage.

The results of 3380 inspections of cantaloups and 574 of Honey Dew melons made at a large number of markets during the period of 1922-28 inclusive, have likewise been summarized. The melons originated in a number of States and represented only a very small part of the melons shipped from these States to the inspection markets during that period. Decay was reported in 879 carlots or 22.2% of the total inspected. An average of 10.7% of the melons were affected per carlot. Expressed in terms of all 3380 carlots, an average of 2.4% of the melons inspected were reported decayed.

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SUPPLEMENT 139

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(Issued November 15, 1945)

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SPRAGUE, RODERICK. A revised check list of the parasitic fungi on cereals and other grasses in Oregon. Supplement 134: 1-36. March 1, 1942

ALTSTATT, G. E. Diseases of plants reported in Texas since 1933. Supplement 135: 37-50. June 15, 1942

ALEXANDER, L. J., RALPH E. LINCOLN, and VEDDER WRIGHT. A survey of the genus _Lycopersicon_ for resistance to the important tomato diseases occurring in Ohio and Indiana. Supplement 136: 52-85. June 15, 1942

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SUPPLEMENT 140

1942 DISEASE INFORMATION FOR THE MIDDLE ATLANTIC STATES

Compiled by

MIDDLE ATLANTIC STATES SECTION
AMERICAN PHYTOPATHOLOGICAL SOCIETY WAR EMERGENCY COMMITTEE

R. S. Kirby, Chairman
Middle Atlantic States Section

March 1, 1943

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Division of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

1942 DISEASE INFORMATION FOR THE MIDDLE ATLANTIC STATES

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R. S. Kirby, Chairman
Middle Atlantic States Section

Plant Disease Reporter
Supplement 140

March 1, 1943

This information was assembled to supply plant pathological workers with facts that are valuable in planning future programs. The crop committee chairman selected the most important diseases from the war standpoint. Each worker was asked to add other important diseases in his own State. The response was prompt and generous and all credit should go to the individual contributors.

R. S. Kirby

Contents

CEREAL CROPS

BARLEY (winter) BLACK LOOSE SMUT (Ustilago nigra)

WEST VIRGINIA: Losses due to black loose smut of barley were perhaps a little less than those due to brown loose smut because some seed is treated with New Improved Ceresan for the control of this disease. Control -- Dust seed with New Improved Ceresan at the rate of 1/2 oz. per bu. Perhaps this would be more effective if an adequate certified seed program were developed and all certified seed treated before being sold. (E. J. Wellhausen)

BARLEY (winter) BROWN LOOSE SMUT (Ustilago nuda)

WEST VIRGINIA: Brown loose smut of winter barley caused about the same amount of damage as loose smut of wheat this year, namely, about 3 to 4%. Very little, if any, barley seed planted in West Virginia has been treated with hot water for loose smut control. Control -- Hot water treatment of foundation seed for certified seed growers. Are urging farmers to buy certified seed only one generation removed from treated seed. (E. J. Wellhausen)

CORN BACTERIAL WILT (Bacterium stewartii)

MARYLAND: Stewart's disease is very common on sweet corn but has not caused any great loss to field corn in Maryland until the 1942 season, when it was very destructive in many fields in early August, causing considerable loss in yield of corn and fodder. Many fields were harvested 2 weeks early in order to save the leaves for feed, at a considerable loss in shrivelled, light, loose grain on a spongy cob. Bacterial leaf blight increased susceptibility to Diplodia stalk rot, which caused considerable corn to break over before harvest. Microscopic examination of bacterial lesions on leaves often showed oozing bacteria and Helminthosporium spores in the same lesion. Estimated loss: 6 to 8% in early-planted corn; 2 to 3% in late-planted corn. However, Helminthosporium leaf blight soon overran and covered up the bacterial lesions. Control -- Plant field corn a week to 10 days later than usual. (E. A. Walker)

PENNSYLVANIA: Very little seen on field corn. (R. S. Kirby)

WEST VIRGINIA: Bacterial wilt seemed to be more prevalent this year, causing more damage on susceptible varieties of early sweet corn in home gardens than last year. No damage was noticed on field corn. Certain fields, however, may have been infected but escaped notice because of Helminthosporium leaf blight. The amount of damage to sweet corn in home gardens and commercial fields is difficult to estimate. It wasn't serious, however, because many of the home gardeners and commercial growers are now using resistant hybrids. In the sweet corn breeding nursery at Morgantown more bacterial wilt was prevalent on susceptible lines but no serious

damage resulted. Control -- Resistant varieties. Resistant varieties of sweet corn are now generally available, and many of the field corn hybrids have also been shown to be resistant. (E. J. Wellhausen)

CORN EAR ROTS (Diplodia and Fusarium)

MARYLAND: Ear rots were more serious than in 1941. Diplodia ear rot was about 5 times more prevalent than Fusarium ear rot. About 75% of the Diplodia ear rot was butt rot. Diplodia stalk rot was very abundant especially where preceded by Stewart's disease. From the result of 5 trial plots of field corn, 4 open-pollinated varieties averaged 5.9% ear rots, and 13 hybrids averaged 2.2% moldy ears. The loss for the State was higher in hybrid corn than shown by the results of the plots. Where the percentage of ear rots was between 0.5 and 1.5, the average yield of corn was 68.7 bu. per acre; between 1.6 and 2.5%, 61.3 bu.; between 2.6 and 3.5%, 59.3 bu.; and between 4.5 and 5.5% it was only 56.1 bu. per acre. Estimated loss -- About 8 to 10% on open-pollinated and 4 to 5% on hybrid corn varieties. Control -- Results during past season show that long-season hybrid corn had less ear rot than shorter-season corn. (E. A. Walker)

CORN LEAF BLIGHT (Helminthosporium turcicum)

MARYLAND: The most severe outbreak of this disease ever observed in the State occurred in 1942. Hybrid and open-pollinated corn were equally affected. It was most destructive in the Monocacy Valley and the northern piedmont section; but was observed in the entire State. The disease appeared in destructive amount at the end of August and fields looked as though fire or frost had scorched the leaves. Leaves used for dry feed were made worthless. Early-planted corn appeared to be worst affected although late-planted corn suffered considerably. The disease was more severe in bottom land with poor drainage.

Grain Yields and Damage from Leaf blight on Corn
Hybrids and Varieties at Five Locations in Maryland

Varieties and hybrids	Yield per acre Bu.	Leaf area blighted* %
	Short Season	
Lancaster Sure Crop	49.9	38.7
Iowa 939	59.2	38.8
Pioneer 314	55.5	35.9
Ohio W-17	53.6	41.3
Average for hybrids:	56.1	38.7

* Some bacterial wilt may have been included.

Varieties and hybrids	Yield per acre Bu.	Leaf area blighted* %
	Medium Season	
Golden Queen	62.4	24.9
Pioneer 300	56.1	49.9
Pioneer 332	61.4	48.6
U. S. 13	63.7	38.0
Funk G-94	62.1	39.1
Iowealth 29-A	61.0	30.7
Average for hybrids:	60.9	41.3
	Late Season	
Reid Yellow Dent	55.3	27.6
Johnson County White	59.0	20.9
Illinois 448	67.8	22.8
Illinois 784	65.9	23.5
Funk G-135	66.3	22.8
U. S. 99	72.7	20.1
U. S. 262	70.0	30.2
Average for hybrids:	68.5	23.9

* Some bacterial wilt may have been included.

From the 5 trials summarized in the table varieties having from 20 to 30% of leaf area affected had a yield of 64.2 bu. per acre; from 30 to 40% infection 61.9 bu.; and from 40 to 50% infection 57 bu.

Estimated loss -- By harvest time 75% of corn in State had badly blighted leaves. Loss of about 10% in weight of grain and 25% loss of leaf for feed.

Control -- Later planting of corn. Avoid planting corn in low land with poor air drainage. Use more of varieties showing resistance in above table. (E. A. Walker)

NEW JERSEY: Leaf blight caused more defoliation late in 1942 than we have ever before observed in New Jersey. A few fields of late-planted corn in the more humid South Jersey areas blighted so severely that they appeared to have been killed by frost. A wet period accompanied by high humidity made conditions so favorable for the disease that young corn was almost totally defoliated in some instances. No efforts have been made to control the blight as its rare occurrence up to the present time has not warranted such action. (C. M. Haenseler)

PENNSYLVANIA: We had the most destructive outbreak of this disease on record. It was most severe in the southeastern and south-central parts of the State and least destructive in the western part. The disease appeared in July about tasseling time and by late August a few severely-affected fields were nearly dead. The average loss for the State was about 12%. In 4 trials in Lancaster County, 4 varieties having less than 20% of leaf area infected had an average yield of 83.3 bu.; 16 varieties with 20 to 30% infection 77.8 bu.; 12 varieties with 31 to 40%, 75.6 bu.; 15 varieties with 41 to 53% infection 73.1 bu.

Control -- Rotation, clean seed, and resistant varieties will be recommended for 1943. Varietal susceptibility was determined in 23 scattered demonstrations. One-fourth of the hybrid varieties had less leaf blight than the average for all open-pollinated varieties and 3/4 had more blight. The average percentage of leaf area infected on different varieties and hybrids in given in the following list:

Percentage of leaf area infected by leaf blight on corn varieties and hybrids in Pennsylvania

Variety or hybrid	Leaf area infected %	Variety or hybrid	Leaf area infected %
	Late maturing		
Golden Queen	9	Funk G-63	36
De Kalb 899	11	Ohio C-90	36
Funk G-135	14	Illinois 784	37
Ohio L-98	17	Pioneer 319	38
Lancaster Sure Crop	18	Ohio C-92	38
Ohio C-38	20	Pfister 164	40
U. S. 13	21	Pfister 4897	40
Eastern Seaboard 129	22	De Kalb 639	40
Funk G-80	23	Pfister 360-A	40
Ohio C-96	23	Pfister 189-Q	40
U. S. 13 Penn Hybrid	23	Pfister 380	40
Iowealth 29-A	23	Great Eastern 601	40
Pioneer 340	23	De Kalb 817-A	43
Pfister 260	24	De Kalb 827	43
Funk G-125	25	Pioneer 300	44
Ohio L-94	26	Funk G-37	45
Funk G-94	26	Pioneer 332	45
Pfister 1863	26	Pioneer 336	45
Ohio C-82	27	Pioneer 333	46
Bucknell 31	28	Pioneer 317	46
De Kalb 840	30	Pioneer 334	46
Funk G-169	32	De Kalb 628-A	47
Pfister 160	34	U. S. 44	50
Ohio C-88	35	Pfister 360	53
Iowealth 25	35	Indiana 608	58

Variety or hybrid	Leaf area infected %	Variety or hybrid	Leaf area infected %
	Medium maturing		
Iowa 939	15	Iowa 459	32
Leaming-Pennsylvania	16	Ohio M-34	32
Ohio W-30	17	Funk G-12	34
Ohio K-35	18	Funk G-15	36
Leaming-Clinton	23	Pioneer 322	40
Funk G-114	25	Ohio W-56	41
De Kalb 404-A	27	Funk G-55	42
Ohio K-24	29	Pioneer 324	42
Ohio W-17	29	Leaming-Ohio	46
	Early maturing		
Ohio K-23	23	Funk G-5	50
Pioneer 353	25	Wisconsin 404	50
Ohio M-15	26	Minnesota 700	50
Clarage	32	Minnesota 800	52
De Kalb 240	36	Wisconsin 275	60
Funk G-4	40	Pioneer 373	69
Ohio M-20	42	Wisconsin 240	75.

(R. S. Kirby)

WEST VIRGINIA: Leaf blight was very severe throughout most of the State, perhaps much more severe than in any previous year. Much of the corn acreage is now planted to hybrids, namely, Ohio W-17, Iowa 939, U. S. 65, and U. S. 13. Probably more Ohio W-17 is grown than all the other hybrids put together. Of these, Ohio W-17 is the most susceptible to blight and Iowa 939 the most resistant. Most open-pollinated varieties seemed to be intermediate between Ohio W-17 and Iowa 939 in susceptibility.

Blight was most noticeable in the eastern panhandle section of West Virginia, primarily in Jefferson and Berkeley Counties. It began to appear in this section early in August and spread very rapidly. Its early appearance and rapid spread was probably due to the fact that most of the corn grown in this area was Ohio hybrid W-17. This hybrid is usually fairly ripe by September 1 in this section and much earlier than the later open-pollinated varieties formerly grown or later hybrids that could be grown. It seems that blight does not readily take hold until the plants reach a certain stage of maturity. Early hybrids seem to show it first or early plantings often show more blight than late plantings of the same hybrid in the same area.

In general, for the State as a whole blight was most outstanding in the longer-season areas where the tendency has been to grow hybrids a little too early for the season. In the shorter-season areas at the higher

altitudes blight was prevalent but much less outstanding. Susceptible hybrids often showed relatively little blight when grown at the higher elevations. Again the earlier plantings at the higher altitudes seemed to be the first to show blight, whereas later plantings in the same vicinity often showed little leaf damage. For the State as a whole blight probably caused little or no reduction in yield of grain. It did, however, reduce the value of the fodder considerably. Most of the corn was pretty well along before it was severely hit. Yields of Ohio W-17 and Iowa 939 have been compared throughout the State for the past 5 years. As an average of 36 trials in different areas of the State prior to this year when blight was not much of a factor, Iowa 939 out-yielded Ohio W-17 by 2.5 bu. per acre. This year with a severe epidemic of blight the resistant hybrid Iowa 939 was compared to Ohio W-17 in 11 different trials throughout the State. The average difference between the 2 hybrids was the same as in previous years; namely, 2.5 bu. per acre in favor of Iowa 939. This does not indicate much damage to Ohio W-17 in grain yields. Even in the eastern panhandle where blight seemed particularly severe, indications are that it caused no appreciable reduction in grain yields. No direct comparisons between Iowa 939 and Ohio W-17 can be made in the eastern panhandle section since Iowa 939 was included in only a few trials in this section. However, a direct comparison between Ohio W-17 and U. S. 13, a later hybrid, can be made. Prior to this year U. S. 13 outyielded Ohio W-17 by 24% as an average of 5 trials in Jefferson county. This year with severe blight on Ohio W-17 and only a moderate amount on U. S. 13, the latter outyielded Ohio W-17 by 22% as an average of 5 trials in Jefferson county, indicating no greater difference between these hybrids than in previous years.

Control -- Since most of the hybrid corn grown in West Virginia is Ohio W-17 many farmers have obtained the idea that hybrid corn is more susceptible to blight than open-pollinated varieties. This, of course, is not true. Other hybrids equally well adapted to West Virginia and more resistant to blight are recommended. In the long-season areas Ohio W-17 could be replaced by U. S. 13, a later hybrid, intermediate in its resistance to blight and a much higher yielder on most soils. In the shorter-season areas, Iowa 939, a highly resistant hybrid and equally well adapted, could be used. (E. J. Wellhausen)

OAT CROWN RUST (Puccinia coronata)

PENNSYLVANIA: Crown rust was the most severe that I have ever seen on late-planted oats in this State. Several fields of late-planted oats in the northern part had 100% infection. Early maturing varieties escaped severe injury. The aecial stage was observed on buckthorn and the red stage on oats in June. The average State loss was about 2%. Control -- Eradication of buckthorn and use of resistant varieties. (R. S. Kirby)

WEST VIRGINIA: Crown rust seemed to be very prevalent causing about 2% damage for the State as a whole. Varieties recommended at present are susceptible but so far have outyielded the more resistant varieties -- even in years such as this one when crown rust was severe. Control -- Eradication of buckthorn; resistant varieties. (E. J. Wellhausen)

OAT LOOSE SMUT (*Ustilago avenae*) and COVERED SMUT (*Ustilago kolleri*)

MARYLAND: Considerable oat smut was present in the oat-growing section which is limited to Western Maryland. Loss was less this year than during the past 5-year period. Loss -- about 3% for the State. Control -- Use of New Improved Ceresan dust. (E. A. Walker)

NEW JERSEY: Most fields show approximately 5% infected heads. Only a small percentage of the seed is treated except that grown for certification. (C. M. Haenseler)

PENNSYLVANIA: There was slightly less smut than usual. The 1942 loss was about 10% as compared to the 10-year average loss of 11.4%. Control -- About half of the oats planted are treated. In sections where oats are grown alone dry formaldehyde treatment leads. In areas where oats and barley or wheat are grown in rotations, New Improved Ceresan is most commonly used. Both treatments are effective. (R. S. Kirby)

WEST VIRGINIA: The average loss due to loose smut of oats this year is estimated at 3%. As with some of the other cereals very little oat seed is treated for loose smut. Control -- Dust seed with New Improved Ceresan at the rate of 1/2 oz. per bu. This can best be done through the development of an adequate certified seed program in which all seed is treated before being sold to growers. (E. J. Wellhausen)

OAT STEM RUST (*Puccinia graminis avenae*)

NEW JERSEY: No observations were made which would indicate that appreciable losses occurred. (C. M. Haenseler)

PENNSYLVANIA: Stem rust on oats in 1942 was first observed on July 16. This disease did not reduce the crop yield more than a trace. As in the case of wheat, the destruction of more than 13,000,000 rust-susceptible barberries in the last seven years has had its effect in reducing stem rust losses. This was especially noticeable in the northeastern and northwestern sections of the State where oats were damaged extensively year after year prior to the removal of the barberry bushes. In these local areas where the barberries have been destroyed, grain producers report crop yields and quality comparable with the best in the State. Control of stem rust on oats is, of course, the same as that for the disease on wheat. These measures include the eradication of rust-spreading barberries, the planting of approved varieties of grain that are resistant to stem rust, and the application of approved cultural practices to produce an early maturing crop. (Donald J. Fitchett)

WHEAT LEAF RUST (*Puccinia rubigo-vera tritici*)

MARYLAND: Leaf rust was severe in all wheat-growing areas and killed leaves before the crop was fully ripe, resulting in many immature kernels and loss in weight. Some additional loss was encountered from

sprouting of wheat in shock following a prolonged period of rain during the early part of August. Estimated loss -- About 10% reduction in weight of threshed grain. Control -- Development of resistant varieties. (E. A. Walker)

NEW JERSEY: Leaf rust was very prevalent in 1942, somewhat more so than in 1941, according to some observers, and about the same according to others. No careful survey was made. (C. M. Haenseler)

PENNSYLVANIA: This year there developed the heaviest and most destructive outbreak of leaf rust occurring for many years. The rust appeared early in the season and many fields were red with rust by blooming time. Most of the leaves were killed prematurely and the grain was small and shrivelled. The average weight per bushel of wheat in 1942 was 15 to 33% below normal. The rust was severe in all parts of the State. It was first observed May 13. The estimated loss was 20 to 25%. Control -- Little difference between varieties was observed. Thorne wheat seemed to have slightly less leaf rust than other commonly grown varieties. If in the future other wet seasons occur as favorable to leaf rust as this, resistant varieties will be needed. (R. S. Kirby)

WEST VIRGINIA: Leaf rust showed up rather late this year, on the whole causing little apparent reduction in yields. Some fields were more severely damaged than others, but on the average it is doubtful whether it caused more than 1% damage. Control -- All varieties now grown are susceptible. If it gets much worse, resistant varieties may have to be introduced. (E. J. Wellhausen)

WHEAT LOOSE SMUT (*Ustilago tritici*)

PENNSYLVANIA: Loose smut causes about 3% loss in susceptible varieties like Pennsylvania 44 and Red Rock but less than 1% in the more resistant varieties such as Leap and Forward. Control -- The establishment of disease-free seed sources for susceptible varieties is the most effective control of smut. In such seed sources the stock seed is treated each year with hot water, then dipped in a Semesan solution. Seed sold to other growers is usually one crop removed from hot water treatment and develops only a trace of loose smut. In the largest seed source in the State, it required some 5 years or 5 treatings and the isolation of stock fields to reduce loose smut to a trace in crops 2 years from hot water seed treatment. (R. S. Kirby)

WEST VIRGINIA: Loose smut of wheat again caused considerable damage this year. The average losses are estimated as 3 to 4%. Losses due to loose smuts tend to average 3 to 4% every year, some fields running as high as 30%. This is primarily due to the fact that very little seed planted in West Virginia is treated. Most farmers grow only a few acres and apparently do not consider treating worth the bother. Control -- Perhaps the most effective way of controlling loose smut of wheat is through hot water treatment of foundation seed for certified seed growers

and urging all farmers to buy seed only one generation removed from certified seed. (E. J. Wellhausen)

WHEAT STEM RUST (Puccinia graminis tritici)

MARYLAND: Stem rust was abundant in Maryland, but developed so late that it caused no appreciable loss to the growers. (E. A. Walker)

NEW JERSEY: No evidence is available which would indicate that appreciable losses occur. (C. M. Haenseler)

PENNSYLVANIA: Stem rust on wheat was first noted on June 4, 1942, in York County. There were no extensive outbreaks of this disease in any area, and the stem rust damage to this crop did not exceed a trace. This is in direct contrast to the picture prior to the time barberries were removed in the wheat growing areas of south central Pennsylvania. Before barberry eradication was started in the Cumberland Valley, for instance, severe damage occurred season after season, but since that time these areas have been free from stem rust loss. Control of stem rust in Pennsylvania depends on the continued suppression of the rust-susceptible barberry, the use of approved varieties of wheat that are resistant to the disease as they become available, the planting of early maturing varieties and the use of cultural practices that result in an early maturing crop. (Donald J. Fitchett)

WEST VIRGINIA: Black stem rust was quite destructive in certain areas of the State this year. It was most severe in the southwestern part where damage ran as high as 30% in some wheat fields. The damage for this area as a whole was estimated at 7%. In the eastern panhandle section the damage was somewhat less severe, being estimated as 3% for the area as a whole. The estimated damage for the entire State was 5%. Control -- The adapted varieties recommended are susceptible. The most practicable method of control seems to be the eradication of barberries. Considerable progress is being made in the principal wheat-growing areas of the State. (E. J. Wellhausen)

WHEAT AND BARLEY SCAB (Gibberella zeae)

MARYLAND: Loss from this disease is generally more than is regularly estimated. Rotation in Maryland with wheat or barley following corn results in increased scab development. Estimated loss -- Barley 1% and wheat 3%. Control -- No satisfactory control recommended. (E. A. Walker)

WEST VIRGINIA: Scab was perhaps the most destructive disease on wheat and barley this year. Some fields of wheat were damaged as much as 50%. The average loss for the State as a whole is estimated at 8 to 10%. Control -- Inasmuch as the practice of following corn with wheat or barley without plowing is universal, and cannot readily be changed, there is no adequate means of controlling this disease in West Virginia. Farmers are urged to cut their corn low, double-disk, covering up as much trash as possible and cleaning up the shock rows when fodder is removed. (E. J. Wellhausen)

FORAGE CROPS

KENTUCKY BLUEGRASS STRIPE SMUT (Ustilago striaeformis)

PENNSYLVANIA: Widespread and often severe stripe smut infection was found in Kentucky bluegrass pastures examined during different seasons in 1941 and 1942. Critical examination of 200 sod plugs 1-3/4 inches in diameter removed from each of 13 widely separated pastures revealed that 2 to 25% of the plugs contained smutted plants. Parts of some pastures yielded more than 35% smutted plugs. Of 75 different pastures examined during the past 2 years, none was found free of the disease. The organism is a systemic parasite and infected plants remain stunted and fail to yield forage comparable to that produced by healthy plants. No measures of control are known to be effective, but it is suggested that less injury to diseased plants may result if close grazing is avoided during the summer periods unfavorable for growth of the grass. (K. W. Kreitlow)

SUDAN GRASS, ALFALFA, AND RED CLOVER - DAMPING-OFF

PENNSYLVANIA: Results of nursery tests conducted at different times during the growing season indicate that seed treatment of some grasses and legumes may be beneficial under a wide range of conditions at time of planting. Preliminary experiments showed that Sudan grass averaged 12% increase in stand when seeds were treated with Spergon or Semesan. Stands of alfalfa were increased 5 to 17% when the seeds were dusted with Yellow Cuprocide, Spergon, or DuBay 1205FF. An average increase in stand of 9% resulted when seeds of red clover were treated with DuBay 1205FF. Tests conducted with orchard grass and Kentucky bluegrass showed no increase in stand when treated seeds were planted. (K. W. Kreitlow)

FRUIT

APPLE BITTER ROT (Glomerella cingulata)

DELAWARE: Bitter rot was a less serious problem than in former years. Infections are usually first noticeable 50 to 60 days after petal fall, but in 1942 the first lesions were not observed until 73 days after petal fall. The disease spread rapidly during August, however, and caused considerable damage in some plantings of certain varieties. Fortunately susceptible varieties are not grown in great number in Delaware. Failure to control bitter rot was shown by analysis to be due to low residues of copper. For susceptible varieties Bordeaux mixture 4-4-100 applied from the 4th or 5th cover spray on as long as needed gave excellent control when spraying was thorough. Lower concentrations give satisfactory control on less susceptible varieties. (S. L. Hopperstead)

MARYLAND: Bitter rot makes its appearance each year about 4 weeks after petal fall in the Costal Plain area where it is favored by warm wet climate. It was not as severe this year as usual in commercial plantings. Applications of stronger Bordeaux mixture spray beginning with

the 2nd cover reduces this disease to a minimum. Unsprayed trees are usually severely affected and only a small amount of disease-free fruit is harvested. Smokehouse, Greenings, and Gano are the most susceptible varieties. Estimated loss -- About 0.5% for the State and 2% for the Costal Plain area. Control -- Increase Bordeaux mixture to 4-6-100 or 6-8-100 depending on the variety. (E. A. Walker)

NEW JERSEY: Bitter rot is of minor economic importance in New Jersey. In seasons when the weather is particularly warm and humid during the ripening period, it becomes a problem on such little-grown varieties as Rhode Island Greening, Winter Banana, and Twenty Ounce. One grower who picks his McIntosh apples and then places them on straw mulch under the trees and leaves them there for a week or two to color up, oftentimes experiences bitter rot during this coloring period. Control -- Spray susceptible varieties with a 5-10-100 Bordeaux mixture applied at 10-day intervals, beginning with the appearance of the disease. (R. H. Daines)

PENNSYLVANIA: Bitter rot is seldom serious except in Southeastern Pennsylvania. The average loss in this section for the past 10 years was: In orchards sprayed as recommended .047%, in partly sprayed orchards .476%, and in unsprayed orchards .303%. In 1942 the loss was very nearly the average for the 10 years. Control -- Only a few varieties such as Polly, Smokehouse, and Winter Banana usually have serious loss. Removal of mummied fruit and spraying with 4-3-100 Bordeaux in 3rd and 4th cover sprays are effective controls. (R. S. Kirby)

VIRGINIA: This disease has been of localized importance in Virginia. Outbreaks have most frequently developed in Yellow Newtown and Grimes Golden plantings, spreading from these to less susceptible varieties. The disease has not been troublesome where no highly susceptible varieties were present. Severe losses were incurred in many plantings in central and southern Virginia in 1942. Control -- Bordeaux of not less than 4-8-100 in the 4th and later cover sprays is necessary for the control of this disease. Mummy removal is necessary and recommended where they have been allowed to develop. (A. B. Groves)

WEST VIRGINIA: Bitter rot was quite severe in the central portion of the State where many blocks of susceptible varieties are poorly sprayed at best. In certain commercial orchards in the eastern panhandle, where sprays were delayed by excessive rainfall, the disease developed on such very susceptible varieties as Summer Rambo and Winter Banana. In such cases further spraying with 4-6-100 Bordeaux resulted in imperfect control of the disease on those varieties, though preventing spread to adjacent, later varieties. (E. C. Sherwood)

APPLE BLACK POX (Helminthosporium papulosum)

NEW JERSEY: A bark necrosis, believed to be black pox has been widespread throughout the central and southern part of the State for at least 20 years. It is unusually common and severe on old Rome plantings and less destructive to Delicious, Jonathan, Transparent and other

varieties. Severely affected trees usually have dead or drying branches or even large limbs. The fruit does not seem to be affected in this area. Control -- The use of boron as a soil treatment has not given relief in experiments that have been in progress for the past 4 years. There seems to be no correlation between spray practices and the occurrence of this disease. (R. H. Daines)

PENNSYLVANIA: Black pox has been destructive for about 5 years, attacking and killing branches and spotting the fruit. The disease this year was the 2nd most severe in 10 years, being exceeded by that of 1938. The disease is widespread in the southeastern part of the State (average of 9.3% unsprayed apples infected), scattered in the northeastern and central parts (trace to 0.4% apples infected) and rather rare in the western part. Black pox is most severe on Red Rome, Grimes Golden, and Smokehouse. Infections on the apples start to appear about September 1 and continue to appear, to and during storage. The loss from black pox is less than 1%. Internal bark necrosis, cause unknown, is found scattered throughout the State on Red Delicious. Control -- Fruit infection from black pox is prevented by having apples covered with Bordeaux 1-5-100 during July and August. Sulphur is not nearly so effective against this disease as is copper. (R. S. Kirby)

VIRGINIA: This disease has not been of sufficient importance in Virginia to justify the recommendation of special control measures. (A. B. Groves)

WEST VIRGINIA: Black pox was not observed in this State in 1942. (A. Berg)

APPLE BLOTCH (Phyllosticta solitaria)

MARYLAND: Blotch was not a serious disease in commercial orchards in 1942. Sprays were adequate in controlling it. Unsprayed trees, principally home orchards, show 10 to 50% blotched. Estimated loss -- about 1.5% for the State. Control -- Regular application of Bordeaux mixture during the cover sprays. (E. A. Walker)

NEW JERSEY: This disease is only occasionally observed on sprayed trees in this area, and then only on the Duchess variety or other varieties near Duchess plantings. (R. H. Daines)

PENNSYLVANIA: Blotch this year was more destructive than in 8 out of 10 years. The 10-year averages are: In orchards sprayed as recommended .03%, in partly sprayed orchards .07%, and in unsprayed orchards 2.5%. Blotch was found on June 26 and caused an average loss of .5%. Control -- On such susceptible varieties as Stark, Smith Cider, McIntosh, and Maiden Blush, Bordeaux 4-8-100 is recommended where twig cankers are present. (R. S. Kirby)

VIRGINIA: This disease is troublesome only on certain varieties, but on these special attention must frequently be given. Susceptible varieties include Northwestern Greening, Duchess, and Golden Delicious. The disease on the latter variety has not appeared altogether typical. Fruit infections usually occur as numerous small lesions surrounded by a conspicuous red halo. Infections other than blotch produce similar small lesions. Isolations have repeatedly confirmed the diagnosis of the disease as blotch. Control -- Blotch has required no special measures other than the use of Bordeaux mixture in the 2nd and later cover spray applications, except where numerous cankers have been allowed to develop. The pruning, trimming, and painting of these cankers has been necessary in such instances, as well as maintaining a good cover of Bordeaux mixture. A copper fungicide is necessary for the control of this disease. (A. B. Groves)

WEST VIRGINIA: Very little blotch was observed in commercial orchards in 1942. Northwestern Greening and Duchess, noticeably susceptible varieties, are grown to a very small extent locally. Most commercial growers of these varieties have, through past experiences, learned to use Bordeaux mixture at the second cover spray. Limited observations indicate that 2-4-100 Bordeaux is much superior to 1/2-2-100 in control of this disease in light infections. (C. F. Taylor)

APPLE FRUIT SPOT (BROOK'S SPOT) (Mycosphaerella pomi)

NEW JERSEY: Fruit spot was unusually common on late-maturing apples where copper sprays were not used in certain cover sprays. Control -- In an experimental block located in South Central Jersey, an average of 87% apples on unsprayed Stayman trees showed fruit spot. Where 3 lbs. of lead and 3 lbs. of lime were used at the 7-, 17-, and 27-day sprays the disease was present on 25% of the fruit. A 1/2-4-100 Bordeaux used with 3 lbs. of lime reduced fruit spot infection to 5.1% of the fruit. Sulfur is ineffective in controlling this disease. However, lead and iron carbamate gave good control. (R. H. Daines)

APPLE FIRE BLIGHT (Erwinia amylovora)

MARYLAND: Severe late outbreak of twig infection came late in June and continued through July following a prolonged rainy period. Blossom infection was very slight. York Imperial, Grimes, Jonathan, and Baldwin showed worst infection. Estimated loss -- About 3% for the State. Control -- Spray at blossoming period with Bordeaux mixture 2-6-100. Remove blighted limbs and burn. (E. A. Walker)

NEW JERSEY: Blossom blight was conspicuous in orchards where the trees were making abundant growth. Control -- Avoid use of too much nitrogen and spray with 2-6-100 Bordeaux during the bloom. (R. H. Daines)

NEW YORK: Fire blight was local and slight throughout the State in 1942 on both apples and pears, being much less serious than in 1941 on apples in the Lake Ontario fruit belt. Control -- The application of

2-6-100 Bordeaux mixture when 3/4 of the flowers are open is included in the apple and pear spray schedules for orchards where fire blight is a problem. The control obtained is often only 50% but even this reduction is worth while. (W. D. Mills)

PENNSYLVANIA: Fire blight was unusually severe throughout the State. For the past 7 years blight has been present in epidemic amounts. This year there was less blossom blight than for several years but twig blight was more severe than for some years. In the southcentral part of the State 25% of the terminals on York and Grimes were infected in some orchards. Blight was first observed on May 15. The average loss in the State was about 2%. Control -- Application of 2-6-100 Bordeaux in bloom has in many cases given commercial control. One large orchard where Bordeaux was applied for several years, has been free of blight. This year only half of this orchard received an application in bloom. Blight was severe where the spray was omitted but almost nonexistent where the spray was applied. (R. S. Kirby)

VIRGINIA: Fire blight was quite severe in Virginia in 1942, occurring principally as a delayed blossom blight. The outbreak might be said to have erupted, it developed so suddenly. There was comparatively little secondary spread. Yorks, Jonathans, Grimes, and Romes were among the most severely blighted, although some plantings of Stayman were also hard hit. Control -- Blossom applications of Bordeaux mixture have been used by some growers and have been tried experimentally. Results have been very spotty however, and the practice is not generally recommended because of severe russeting which frequently develops. Pruning and canker treatments have not been sufficiently beneficial to justify their recommendation to the average grower. In the hands of a trained operator, better results might be anticipated. It is felt that the manner of initial spread of this disease is not well-enough understood to provide a basis for sound effective control measures. (A. B. Groves)

WEST VIRGINIA: Severe outbreaks of fire blight occurred throughout the State. These outbreaks were sporadic even on the most susceptible varieties, and are believed due to the relative abundance of hold-over cankers in the general vicinity. Only a limited amount of blossom spraying was done, many growers choosing to assume the risk of severe injury by fire blight rather than suffer possible severe russeting of the fruit. Where the blossom spray was used, the disease appeared to be less prevalent. (E. C. Sherwood)

APPLE RUST (*Gymnosporangium juniperi-virginianae*)
QUINCE RUST (*Gymnosporangium clavipes*)

MARYLAND: Cedar rust was not as serious in 1942 as in the previous year on account of a prolonged dry period following blooming. Yorks, Grimes, and Golden Delicious showed more leaf and fruit infections than other commercial varieties in areas planted near cedar trees. Estimated loss -- About 1.5% for the State. Control -- Eradicate redcedar trees

near commercial orchard. (E. A. Walker)

NEW JERSEY: Owing to dry spring weather the incidence of rust infections has been very low in New Jersey orchards during the past 2 years. Apple rust is normally more common than quince rust in this area. Control -- Eradication of redcedar. (R. H. Daines).

NEW YORK: Both apple rust and quince rust were local and very slight in the Hudson Valley in 1942, being much less than in 1941. Hawthorn rust (G. globosum) was local and very slight in both years. Control -- Fermate has been shown in Hudson Valley experiments to be a much more effective fungicide than sulfur against the cedar rusts, although slightly less effective than the better elemental sulfurs in scab control. For the Hudson Valley, where cedar rust is very important and eradication of cedars impractical, our 1943 spray schedule will suggest the use of 1/2 lb. Fermate and 3 lbs. elemental sulfur per 100 gals. in preblossom and bloom sprays, if needed, for the control of both cedar rust and apple scab. (W. D. Mills)

PENNSYLVANIA: Dry weather during and immediately following bloom in the areas where cedar-apple rust is severe reduced rust in 1942 to about 1/3 of the 10-year average. The apple rust is about twice as destructive on fruit as is the quince rust. Counts in over 300 orchards during the past 10 years give the following percentages of rust-infected fruit: in orchards sprayed as recommended, 0.1%, in partly sprayed orchards 0.07%, in unsprayed orchards 0.04%. Control -- Eradication of redcedar. (R. S. Kirby)

VIRGINIA: Apple (cedar) rusts have continued to be a problem in many orchards adjacent to uncut cedar areas, even though redcedars have been cut back for the specified 2 miles. Fruit and leaf infection were severe on York and Jonathan in northern Virginia in 1942. No recommendation of spray practices to supplement the usual cedar cutting program has been made, although their possible merit is being investigated. Quince rust is frequently severe on such varieties as Stayman and Delicious, often going unrecognized because of its occurrence on these varieties which are quite resistant to the common apple rust. Typical lesions appear as dark green areas, usually slightly depressed at the margins and slightly raised in the center. They do not greatly differ from common apple rust lesions except that they are dark green, never orange, and are smooth (do not produce aecia). (A. B. Groves)

WEST VIRGINIA: Loss in the commercial orchard section was slight in 1942. This is attributed chiefly to extensive cedar cutting in 1940-41. (C. F. Taylor)

APPLE SCAB (Venturia inaequalis)

DELAWARE: Apple scab was of little consequence in Delaware during the past season. Although the perithecia were matured and the spores shot during the critical scab periods the rains were of too short duration to allow infection. Unsprayed trees of susceptible varieties had less than 5% infection 20 days after petal fall. (S. L. Hopperstead)

MARYLAND: Scab was not a problem with commercial growers this year, being much less abundant than is present in a normal season. A dry season prevailed during April, May, and June with heavy rainfall during the remaining crop period. Although developing scab perithecia were abundant, ascospores matured late (June 6) and irregularly. Moisture was lacking in which to germinate spores. Even unsprayed home orchards showed less than 10% of the fruit infected. Leaf infection developed late in August. Estimated loss -- About 1% for the State in commercial orchards, 5 to 8% in unsprayed trees of susceptible varieties. Control -- Accurate timing of early sprays with maximum ascospore discharge. Use lime sulfur (1-75) in pre-blossom sprays; wettable sulfur in petal fall and 1st and 2nd cover sprays; and 1/2-2-100 Bordeaux mixture in remaining cover sprays where bitter rot is not a problem. (E. A. Walker)

NEW JERSEY: Because of the relatively dry spring, apple scab was not a serious problem in New Jersey this past growing season. Although the disease was common in unsprayed orchards, it was difficult to find in sprayed blocks. Control -- Lime sulfur or wettable sulfur was used in the pre-blossom sprays, whereas wettable sulfur was used in the petal fall and 7-day applications. (R. H. Daines)

NEW YORK: Apple scab was general and moderate to severe in poorly sprayed orchards throughout the State in 1942. Early in the season scab was general but slight to moderate in amount, but the amount increased during late summer and the injury to fruit was higher than usual. A number of growers as well as our experimental staff obtained excellent control with schedules of elemental sulfur. The practice of dusting or spraying with elemental sulfur during scab rains is increasing rapidly. The sprays and dusts both give excellent control providing they are applied before infection has occurred. The time during which these elemental sulfur applications are effective varies with the prevailing temperature and the presence or absence of abundant, mature perithecia in the orchard. (W. D. Mills)

PENNSYLVANIA: In 44 scattered unsprayed orchards an average of 50.7% of the apples were scabby. This was 23.2% less scab than the average for the 13 preceding years. In only one year, the drought year of 1936, was there less scab. Scab occurrence was variable. In northwestern Pennsylvania where rainfall was above normal in April, May, July and September, a severe outbreak occurred and most unsprayed orchards had 100% infection. In the southwestern, central and northeastern parts with rainfall below normal in April, normal in May, and above normal in June and July, scab was slightly below the 13-year average. In the far southeast little rain fell until the 2nd cover spray and the remainder of the season was abnormally wet. Here only 13% of unsprayed apples were scabby. The average State loss was about 5%. Control -- Fifty-five counties receive spray service. Lime sulfur was recommended in the pre-blossom sprays, wettable sulfur in petal fall and first cover. In the 3rd and 4th cover Bordeaux 1-5-100 was used in eastern and central parts while sulfur was used in northern and western parts of the State. Average amount of scabby apples

in 140 orchards sprayed as recommended was 1.79%. The most important scab sprays were petal fall in northwest (40% scab where omitted), 3rd and 4th covers (6 to 21% scab where omitted, except in south-central 3.1%), delayed dormant and pink sprays in northwest (7% scab where either spray was omitted). (R. S. Kirby)

VIRGINIA: Scab has been of appreciable consequence in Virginia about 1 year in 3; a severe outbreak occurs about 1 year in 5. There was very little scab in Virginia during 1942, owing apparently to delayed maturity of ascospores and low early season rainfall. Very few spores were discharged before the first week of June, at which time high temperatures and adequate fungicidal covering on most varieties served to keep infection at a minimum. Late season or storage scab has been a factor twice during the past 15 years, occurring in seasons in which scab was not controlled in the spring and prolonged rains occurred during late summer or early fall. A 1942 outbreak was probably avoided only because of the lack of early season infection. Control -- Lime sulfur 1-50 is recommended in the pre-blossom and petal fall sprays, and is frequently used in the first cover application. Flotation and wettable sulfurs are also widely used in these applications, as well as in later sprays. The use of Bordeaux 2-4-100 usually begins with the 2nd or 3rd cover but because of the critical copper situation, elemental sulfurs will be recommended through the 2nd cover sprays. Following this only one fungicidal strength Bordeaux spray will be recommended for each series of codling moth brood sprays, and here only on varieties susceptible to scab. Other varieties will receive lead and lime, or lead, lime and wettable sulfur. (A. B. Groves)

WEST VIRGINIA: Apple scab was widespread and severe in the central and southern sections of the State. In the eastern section, where better spray practices are followed, only a trace of loss was caused. In 1942 scab was very late in developing, probably owing to deficient moisture during the winter and to drought conditions during April. The petal-fall spray was the most important control spray. Development during the wet weather of the past summer was prevented by the Bordeaux mixture used as a safener in the lead arsenate sprays. (E. C. Sherwood)

APPLE SOOTY BLOTCH (Gloeodes pomigena) and
FLY SPECK (Leptothyrium pomi)

MARYLAND: These diseases were very common on unsprayed apples. Regular spraying gave perfect commercial control. Heavy rainfall and high humidity accounted for rapid spread of these diseases. Estimated loss -- About 2% for the State. Many unsprayed trees in home orchards had 90% infection. Control -- Spray with light application of Bordeaux mixture (1/2-2-100) in cover sprays. (E. A. Walker)

NEW JERSEY: These diseases caused severe losses in poorly sprayed orchards this past year, but were of no importance where sprays were thoroughly applied. Control -- In an experimental block located in the south-central part of the State, an average of 97% of the apples on unsprayed

trees showed these diseases, whereas only 5.2% was present on trees sprayed with 3lbs. of lead arsenate, and 3 lbs. of lime at the 7-, 17-, 27-day applications. (R. H. Daines)

NEW YORK: Slightly more sooty blotch appeared in 1942 upon apples and the disease was locally severe upon Keiffer pears in the Hudson Valley. Control -- In addition to the cover sprays with their known value in control Dr. Palmiter has obtained some interesting results with certain dormant sprays. These are still in the experimental stage and probably no dormant sprays will be recommended for the control of sooty blotch this coming season. (W. D. Mills)

PENNSYLVANIA: We had the most severe outbreak of these diseases on record. An average of 70.6% of unsprayed apples were infected. This was 37.8% above the average for the 13 preceding years. These diseases were most severe in the southeastern part of the State (98% unsprayed fruit infected) where rainfall during July, August and September was 45% above normal. In the northeast rainfall was 39.5% above normal and 83% of the fruit was infected. In the central part rainfall was 24.2% above normal and 80% of the fruit was infected. In the western part of the State rainfall was 10.7% above normal and 6.6% of the apples were infected. The disease was first observed on July 31. The average State loss was about 4%. Control -- Following the spray schedule as outlined under apple scab held these diseases to 0.2%. The most important sprays for control are best shown in demonstrations in southeastern Pennsylvania where each spray was left off different blocks of trees. All sprays except 1st cover = 3.6% apples infected. All sprays except 3rd cover (mid June) = 14.4% apples infected. All sprays except 4th cover (mid June) = 21.9% apples infected. Bordeaux was observed to be more effective than any form of sulfur in preventing these diseases. (R. S. Kirby)

VIRGINIA: These 2 diseases were more abundant in Virginia during 1942 than for several seasons, apparently because of the abundant late season rainfall. Sooty blotch in particular developed rapidly during the late summer and early fall. Little trouble was experienced where the regular fungicidal applications were made. No special recommendations are made for the control of these 2 diseases as none are felt to be necessary. (A. B. Groves)

WEST VIRGINIA: These diseases were prevalent in the central and southern sections of the State where many home orchards are unsprayed. In the eastern panhandle, where Bordeaux mixture was added to the cover sprays to act as a safener against arsenical injury, control was excellent. It caused little, if any, reduction in grade in sprayed orchards. (E. C. Sherwood)

CHERRY (sour) LEAF SPOT (Coccomyces hiemalis)

NEW JERSEY: Complete defoliation of unsprayed and sulfur-sprayed trees by early in August was common throughout the State. However, where certain copper fungicides were used in the post-harvest applications,

defoliation did not occur until October. The foliage on Bordeaux-sprayed trees showed excessive copper injury. A pronounced yellowing of the foliage followed by a heavy leaf drop occurred on one commercial block following the use of lime sulfur (1-50) during a warm humid period. (R. H. Daines)

NEW YORK: Cherry leaf spot was quite abundant late in the year. For the third successive year schedules of both lime sulfur at 1-40, and 1-1/2-6-100 Bordeaux plus a spreader, dwarfed the size of the cherries in comparison with paste sulfur plus a sticker, and fixed copper plus a sticker. For the 3-year period the total yield on the flotation sulfur sprayed trees has been highly significantly larger than on the trees receiving Bordeaux or lime sulfur. The fixed-copper schedule has given a highly significant increase in yield over Bordeaux and a probably significant increase over the lime sulfur. The trunk girth increase for the 3 years is highly significantly smaller for the trees receiving lime sulfur than with those receiving the other 3 treatments. The control of leaf spot has been superior with the 2 copper schedules but in the worst year over 80% of the leaves were retained in late August and over 60% were retained on October 1 with all treatments.

A split schedule of lime sulfur and bordeaux was reported in Michigan by Dutton in 1923 to cause serious foliage injury in nearly every instance. Complete defoliation to sour sherries by Bordeaux following lime sulfur in 1920 was reported in New York in 1921. I agree with Dutton who said,

"Some growers have preferred to use Bordeaux because of its excellent fungicidal properties, but, because of the dwarfing effect on the fruit, have substituted lime-sulfur for all or part of the applications before harvest and then made the after-harvest application with Bordeaux. Such practice, in 1923, resulted, in nearly every instance, in serious foliage injury. Reports of such injury were received from nearly all cherry growing districts. In experiments at Traverse City, . . . the materials were alternated in various ways; from lime sulfur to Bordeaux and from Bordeaux to lime sulfur. The changes were made at different applications but the result was always the same; severe foliage injury followed, regardless of which way the change was made or at what period it occurred. Such changes have been made in other years without apparent ill-effects but because of the possible serious results which may follow under some conditions, the practice must be considered unsafe."

Our growers have been using flotation paste and shifting to a fixed copper when and if leaf spot appears. So far no visible injury or dwarfing of the cherries has occurred. In one instance in 1940 a shift from lime sulfur to Bordeaux mixture in July caused no visible spray injury but the cherries were so dwarfed that 160 cherries were required to make a pound. Many growers shifted from lime sulfur to fixed copper at the same time and effectively stopped leaf spot without visible injury.

The cherry leaf spot fungus usually matures its spores during the bloom period of sour cherry and ascospores are often discharged before the petal fall stage. However, the leaves are not susceptible to infection until the stomates open at or shortly after the petals fall. Our occasional year of very serious damage by leaf spot usually is initiated by an infection prior to the shuck-fall stage. The Wisconsin data for a long period

seem to indicate the same thing to be true in that State. 1928 was such a season in western New York. Counts made July 5 on Montmorency cherries showed 7% of the leaves showing leaf spot on the trees receiving both the petal fall and shuck sprays. On trees receiving the petal fall and no shuck spray 18% of the leaves were infected while on the trees omitting the petal fall but receiving the shuck spray 47% of the leaves showed leaf spot. The sprays consisted of lime sulfur 1-40 with 2-1/2 lbs. lead arsenate per 100 gals. Such experiences have convinced us that at least in orchards on a sulfur schedule the petal fall spray may not safely be omitted on sour cherry. (W. D. Mills)

PENNSYLVANIA: Cherry leaf spot was abundant in southern Pennsylvania. Unsprayed trees were completely defoliated by the middle of August. It was again demonstrated that 4 applications of lime sulfur will not hold the foliage in a satisfactory manner, whereas 2 applications of lime sulfur followed by 2 of Bordeaux mixture 2-8-100 kept the trees in good foliage until about October 1. The petal fall spray appears to be of little or no value in leaf spot control. Four sprays of Bordeaux or certain other coppers are satisfactory, but because of injuries to fruit, cannot be recommended. A part sulfur, part Bordeaux schedule appears to be the best at present under Pennsylvania conditions. (H. W. Thurston, Jr.)

VIRGINIA: Cherry leaf spot was quite abundant in Virginia last year, although perhaps not so severe as in sections to the north. The initial infection was later than usual, although secondary spread was rapid enough to defoliate unsprayed trees by late summer. Control -- Experience indicates a split schedule of lime sulfur and Bordeaux mixture to be perhaps the best for leaf spot control and production of uninjured fruit. (A. B. Groves)

WEST VIRGINIA: Initial development of the cherry leaf spot fungus was delayed in 1942, in consequence the petal fall spray was of little importance in control. A full schedule of lime sulfur was inadequate in preventing leaf spot. Any schedule which called for the application of at least one copper spray before, and one after harvest provided adequate control of leaf spot. Owing to the occurrence of fruit injury in the copper spray plots, it appears desirable to use a minimum copper schedule next year. In 1943 it is planned to recommend the following spray schedules:

(A) - (If a pre-harvest application is to be made) 3 lime sulfur sprays, followed by a fixed copper at the pre-harvest period, and either fixed copper or Bordeaux mixture at the post-harvest period.

(B) - If no pre-harvest application is planned, it is recommended that 2 sprays of lime sulfur be followed by a fixed copper spray at the three-weeks period and at the post-harvest period. (C. F. Taylor)

PEACH BROWN ROT (Monilinia fructicola)

MARYLAND: Brown rot is our worst peach disease. Dry weather early in the season reduced blossom blight. The disease increased rapidly on

ripening fruit in July and August during the exceedingly wet period. Growers managed to keep foliage and fruit covered between rains so that loss was kept to a minimum. Considerable fruit rotted on vigorous J. H. Hale trees even where the best spraying was done. Sulfur dusting was continued during the ripening period by commercial growers. Application of sulfur to fruit at packing time prolongs the storage life of peaches by keeping down brown rot. Estimated loss -- Loss in commercial orchards about 3.5%; in home and unsprayed orchards 85%. Control -- Dry-mix lime sulfur or wettable sulfur at blossom time and petal fall aids in the control of blossom blight. Frequent applications of wettable sulfur sprays before harvest and of sulfur lime dusts at harvest time effectively control the disease. Some growers pick up all drop peaches after harvest and bury them, thus reducing the inoculum for the next season. (E. A. Walker)

NEW JERSEY: Blossom blight has been less common than usual during the past 2 years, owing, no doubt, to the dry weather we have experienced during the blooming period. This disease spread rapidly in poorly sprayed plantings during the fruit softening period when wet weather was common. In orchards that were thoroughly dusted or sprayed during this period, the losses from brown rot were not great. (R. H. Daines)

NEW YORK: Brown rot apothecia were found in considerable numbers on old mummies of peach and plum in late April but dry weather during bloom prevailed and little blossom blight developed over most of the State. Fruit rot was general but moderate in most areas upon peaches and prunes. Only slight loss was caused on sour and sweet cherries.

Control -- Mr. Fred Lewis of this department has been conducting some experimental work upon the use of Fermate as a bloom spray upon peaches for the control of brown-rot blossom blight. Results were encouraging with no reduction of fruit set when Fermate was applied at 1-1/2 lbs. per 100 gals. in full bloom and with a highly significant reduction in brown rot from 60.9 to 42.5 cankers per tree. These were young trees of the Valiant variety which is very susceptible to brown rot and conditions were very favorable for brown rot infection. Insufficient work was done on blossom applications of Fermate upon sweet cherries to draw conclusions, but upon these self-sterile varieties a reduction of set seemed to result. These are unpublished data of Mr. Lewis but we extension men are constantly using such data with proper precautions.

Some encouraging results with the control of brown rot and of Botrytis rot of sweet cherries by the use of Fermate before harvest were reported at the New York State Horticultural Society in January 1942 by Dr. D. H. Palmiter. Further experimental work this year indicates that an application of Fermate before harvest prolonged, for a week, the period in roadside stands that sweet cherries could be held without rotting. (W. D. Mills)

PENNSYLVANIA: Dry weather early in the season prevented old mummies on the ground from forming apothecia. There was much less blossom blight than occurs most years. A wet season from mid June to harvest enabled brown rot to develop very rapidly. The average State loss was about 15%. This loss was exceeded in only 2 of the last 11 years. The loss in completely sprayed orchards was under 5%. In partly sprayed and unsprayed

orchards the loss was from 5 to 100%. Control -- The 1st to cover and week before harvest spray were the most important in preventing loss. Wettable sulfur sprays were effective. One orchard omitted the last 2 sprays in one block of trees and lost all their crop in this block. In adjoining blocks where the sprays were applied the loss was below 5%. (R. S. Kirby)

VIRGINIA: Blossom blight is normally of little importance in northern Virginia, although occasionally troublesome in the Piedmont area. No blight was observed in 1942 owing no doubt to the dry early season. Fruit losses were above normal, but not of serious proportions in well sprayed plantings. Control -- Wettable sulfurs are recommended and almost universally used. Four applications at approximate 3-week intervals with the first spray beginning in early June have proven adequate. A pre-harvest application of sulfur at from 2 to 3 lbs. per 100 gals. (no lime) is widely used and affords additional protection through the critical harvest period. (A. B. Groves)

WEST VIRGINIA: Brown rot was very severe on early peaches in all parts of the State, the crop being a total loss in some unsprayed orchards. Loss was generally less severe in the later varieties. However, in some local situations delay in applying the 2nd cover allowed the disease to start, mainly on fruits injured by insects or other causes. Prompt attention to the removal of this source of infection followed by sulfur applications, checked the disease and very little actual loss occurred, increased size compensating for the removed fruit. (E. C. Sherwood)

PEACH CANKER (Fusicoccum spp. and Valsa spp.)

NEW JERSEY: Peach canker was less severe in South Jersey during the past 2 years than it was during the 2 or 3 preceding years. The cold weather of the 1941-1942 winter killed many young trees that had been affected with trunk cankers 2 and 3 years earlier. Control -- Experiments in which various kinds of spray materials were applied during the defoliation period and during the blooming period have failed to give control of this disease. The severity of the disease has been greatly decreased in local areas, following the removal and burning of old badly diseased trees, accompanied by careful pruning and destruction of trimmings of the affected younger trees that were not removed. (R. H. Daines)

PEACH VIRUSES

MARYLAND: Peach yellows and little peach are on the decline since the eradication program was inaugurated in 1940 and 1941. These diseases are confined mostly to home orchards and scattered roadside seedlings. Commercial orchards are free or comparatively free of viruses. Estimated loss -- About 0.5% in 1942. Control -- Eradicate and burn trees as soon as they are discovered in the orchards. (E. A. Walker)

NEW JERSEY: Yellows and little peach - One case of yellows and several cases of little peach were observed in New Jersey last summer. All observed cases were located in the central and northern part of the State. Control -- Eradication strongly advised. (R. H. Daines)

PENNSYLVANIA: Yellows - A severe outbreak of yellows occurred in 1941. The disease was most severe in the western part but increase was noticed in all parts of the State. In 1942 there was only about 1/3 the loss of the previous year (3% in 1941 and 1% in 1942). Control -- Eradication is recommended.

X-disease or yellow-red virosis - Infected choke cherries (*Prunus virginiana*) have only been found in 6 counties in the northwestern part of the State. In 2 of these counties peaches growing near infected choke cherries showed symptoms. (R. S. Kirby)

VIRGINIA: Yellows - The outbreak of yellows which appeared to threaten in 1941 failed to continue developing at the rate apparent a season earlier. Numerous new cases were located, however, and a few formerly disease-free orchards were added to the list of infected plantings. Control -- Eradication is recommended and generally practiced. Nicotine sulfate 1-800 applied at the time of plum leaf hopper hatching was suggested for trial in orchards where many new cases were observed, and a few such applications were made. Their value cannot be estimated at this time.

Yellow-red virosis - This disease has not been observed in Virginia, owing perhaps to the general location of peach plantings, which are quite distant from wild chokecherry thickets. (A. B. Groves)

WEST VIRGINIA: Yellows - This disease was less prevalent in 1942 than in 1941. In 1942 very little yellows developed in commercial orchards. However, many of the trees in home gardens in small villages in the same region showed well-developed symptoms. The disease was more prevalent than in a normal year.

Yellow-red virosis was not found in West Virginia. (C. F. Taylor)

RASPBERRY ANTHRACNOSE (*Elsinoë veneta*)

MARYLAND: The season was relatively dry this year and anthracnose caused a loss of about 2%. It is a constant factor in production and constitutes an ever-present menace in most plantings. Control -- Removal of "handles" from black raspberry sets as soon after planting as possible. Removal and destruction of heavily infected new canes. Prompt removal and destruction of fruiting canes after harvest. Control of weeds to allow free air circulation; and spraying with the following: 1.--Lime sulfur 1-12 when buds begin to break in spring; 2.--Bordeaux 2-4-50 about 1 week before blooming; 3.--Bordeaux 2-4-50 as soon as blossoming is over and again as soon after harvest as possible. (W. F. Jeffers)

NEW JERSEY: Raspberry anthracnose is of minor importance on Latham and Ranere, our only commercial varieties, except in certain seasons when weather conditions are unusually favorable for the disease. It has been far less prevalent in recent years since spraying has become more generally practiced. The same disease is much more severe on dewberries, where spraying with liquid lime sulfur 1-40 at delayed dormant followed by Bordeaux mixture 6-8-100 at pre-blossom, has given very satisfactory commercial control. Spraying is not commonly practiced on dewberry, however. The same schedule is advised for raspberries and is used by many growers. (C. M. Haenseler and J. H. Clark)

PENNSYLVANIA: This principal fungous disease was found to be State-wide in distribution. It occurred on all black varieties, on the red varieties, Taylor, and on blackberries. The abundant wet weather favored the early development of the fungus which was well established by June 15. This disease caused a loss of about 8%. Control -- The disease did a minimum amount of damage in patches that were sprayed 2 to 3 times with 1-50 liquid lime sulfur. (George L. Zundel)

VIRGINIA: This disease has been perhaps the most troublesome disease of raspberries in Virginia. Late dormant applications of Elgetol 1/2 to 100 have markedly reduced early infection, although cover sprays were necessary to prevent the subsequent development of infections. Both lime sulfur and Bordeaux mixture are used, neither with entire satisfaction as regards both disease control and spray injury. (A. B. Groves)

WEST VIRGINIA: Anthracnose is universally present. Raspberries are grown on a small scale and spraying is not a consistent practice. Current season infection was heavy in the few plantings observed. It was favored by frequent rains. (J. G. Leach)

RASPBERRY VIRUS

MARYLAND: Green and yellow mosaic diseases occurred to some extent in most of the plantings but as usual did not cause more than 2% loss for the State as a whole. Some plantings, in which roguing had not been practiced and where other precautions had not been observed, suffered higher losses.

Severe Streak.- Most of the black raspberry plantings in western Maryland contained some severe streak. Affected plants are recognized by the growers and eradicated.

Mild Streak - This is the most serious raspberry disease in Maryland, causing about 8% loss for the State as a whole. As mild streak is very difficult to recognize it is usually spread freely in nursery stock and thus certain plantings were found to have as much as 50% infection. The loss from this disease results from the drying up of fruit before it matures.

Control -- Virus diseases are controlled by planting disease-free stock and by careful roguing. (W. F. Jeffers)

NEW JERSEY: Mosaic is very common in all commercial plantings which are several years old, but where proper cultural practices are followed and the plantings renewed frequently the crop losses due to mosaic are not great. Satisfactory yields can be maintained in the Latham and Ranere, our 2 commercial varieties, where plantings are made with mosaic-free stock, the new planting isolated from old diseased fields, the young field rogued for the first 2 years, proper fertilization and cultivation practiced to encourage strong cane growth, and new plantings made sufficiently frequently and old plantings destroyed as soon as they show signs of decline. Our most serious trouble with mosaic occurs where plantings are made, as they too frequently are, from stock taken from our old fields which are severely infected with mosaic. (C. M. Haenseler and J. H. Clark)

PENNSYLVANIA: The mosaics were general throughout the State. In well-cared-for commercial plantings the damage was slight. The streak diseases were found to have a State-wide distribution, being especially severe in the northwestern and southeastern parts. Leaf curl was found only in isolated patches. The total loss was about 3%. Control -- The presence of virus diseases was traceable to the failure to use disease-free plants, to close proximity to diseased wild or cultivated brambles, or to not properly roguing the berry patches. (George L. Zundel)

WEST VIRGINIA: Raspberry mosaic is of general occurrence in West Virginia but no accurate data on prevalence or severity are available. (J. G. Leach)

RASPBERRY WILT (Verticillium sp.)

MARYLAND: Owing to the practice of planting raspberries after tomatoes and potatoes many raspberry plantings in western Maryland are severely infested with Verticillium wilt. This disease is especially severe on poorly drained soil. Approximately 5% loss was caused by this disease last year but some growers suffered 10 to 20% loss. Control -- Do not set raspberry plants in poorly drained soil or areas subject to surface washing. Do not set raspberry plants immediately following potatoes or tomatoes. Use healthy planting stock. Maintain good soil fertility. Avoid transfer of soil from affected to clean plantings. (W. F. Jeffers)

RASPBERRY NON-PARASITIC DISEASE

MARYLAND: A condition which we are calling "fern-leaf" in Maryland has been noted in many Washington County plantings. The symptoms consist of a twisted and malformed growth of leaves, mainly on new canes. It is thought that this condition is the result of winter injury. (W. F. Jeffers)

STRAWBERRY RED STELE (Phytophthora fragariae)

MARYLAND: The red stele disease of strawberries is especially serious in several sections of the Eastern Shore of Maryland where poor drainage conditions exist. As the red stele organism lives in the soil for 10 years or more and is readily spread by surface water and by cultivating implements, etc., it has become the most serious disease of strawberries in Maryland and is rapidly assuming similar proportions in many other States. Estimated loss -- Approximately 25 to 30% loss in the strawberry crop occurs each year on the eastern shore from red stele. Loss for the State as a whole averaged about 8%. Control -- Control measures consist in planting healthy plants on clean soil and use of resistant varieties. Aberdeen and Pathfinder are the only commercial varieties at present showing resistance to the red stele disease. Several new resistant varieties will soon be released. (W. F. Jeffers)

NEW JERSEY: The red stele disease has caused very minor losses in commercial plantings. Thorough State-wide surveys, and a careful State inspection service supplemented by a vigorous educational campaign started immediately after the first infected planting was detected in 1937, and

focused on the urgent need of eradication of infected plantings and on the advantages of using only disease-free stock, have not only kept the red stele disease from increasing but have definitely reduced the number of known infected fields. Several varieties resistant to red stele, including Pathfinder and N. J. 312, have been developed here and other promising resistant seedlings are being tested. (C. M. Haenseler and J. H. Clark)

NEW YORK: Red stele has not yet appeared to be of commercial importance in New York State. In all cases investigated to date the incidence of the disease has been confined to areas of the fields too low and wet for strawberries under New York conditions. In cooperation with Dr. M. B. Hoffman, Extension Pomologist, the soil and subsoil in affected patches have been examined by the use of a soil tube. One grower calls it "wet stele" instead of red stele and the name appears justified so far as our limited experience with the trouble goes. (W. D. Mills)

WEST VIRGINIA: None observed. (J. G. Leach)

ORNAMENTALS AND TURF

AFRICAN-VIOLET (Saintpaulia)

NEW YORK: Powdery mildew (Oidium sp.) was seen in abundance in 2 greenhouses. Apparently it was distributed from a single contaminated source of plants. (A. W. Dimock)

CALLA LILY

NEW YORK: Spotted wilt (Lycopersicum virus 3) is seen increasingly in eastern greenhouses on recently purchased rhizomes from the West Coast. This should be recognized as important source of infection for tomatoes, peppers, and other food plants commonly started in mixed greenhouses.

Root rot (Phytophthora richardiae) was very common last winter, owing to laxity on part of growers. Control -- The standard formaldehyde treatment of rhizomes plus soil and container sterilization will give excellent control. Thiosan 1 lb. in 50 gals. for 90 minutes failed to give complete control but looked promising. (A. W. Dimock)

CARNATIONS

NEW YORK: Mosaic - An undescribed virus disease was very common this past winter and early spring and caused considerable loss in many varieties. The nature of the disease is not yet too clear.

Leafspot and branch rot - (Alternaria dianthi) - was exceptionally severe this season on field grown stock which was not benched before first week of July. Heavy, continued rains started at that time. (A. W. Dimock)

PENNSYLVANIA: Leafspot and branch rot this year were more severe than usual and caused at least 12% loss to the commercial growers. Control -- The double treatment of cuttings continues to reduce disease when combined with other control measures. Cuttings are first immersed in

1-1000 potassium permanganate, next the cut ends are dipped into dusts containing indolebutyric acid or naphthyl acetamide. (R. S. Kirby)

CHINA ASTERS - WILT (Fusarium conglutinans callistephi and Verticillium sp.)

MARYLAND: Both wilts were more common in 1942 than in other years. Estimated loss -- About 4%. (E. A. Walker)

NEW YORK: Fusarium wilt was severe in many plantings. Verticillium wilt probably was more common than is realized, the disease usually being attributed to Fusarium. (A. W. Dimock)

CHRYSANTHEMUM - WILT (Verticillium albo-atrum)
NEMATODE LEAF BLIGHT (Aphelenchoides fragariae)
SEPTORIA LEAFSPOT (Septoria chrysanthemi)

NEW JERSEY: The extremely rainy summer of 1942 probably accounts for the sharp increase of both Verticillium wilt and the foliar nematode. Some varieties of mums showed 100% infection by the Verticillium fungus in some plantings. The foliar nematode appears to attack a wider range of varieties, although a considerable range of susceptibility is also apparently present. There is still time for pathologists to inform county agents that losses from both troubles can be sharply curbed on next year's crop by taking certain precautions. Probably the most important is the method of propagation. Top cuttings of vigorous growing plants, as suggested by J. R. Christie, U. S. D. A.; A. W. Dimock, Cornell; and Paul Tilford, of Ohio State, seem to be of great help in reducing initial infections. This practice should be supplemented with sub-surface watering of propagating stock (to avoid leaf-wetting) and the use of clean soil or of disinfested old soil. (P. P. Pirone)

NEW YORK: Septoria leafspot and leaf nematodes were very severe in clothhouse and open-grown plantings because of the rainy season. Wilt was severe, though probably no more so than usual. Excellent control of Septoria leafspot was given by Fermate at 1-1/2 lbs. and 1 lb. per 100 gals. and by 4-4-100 Bordeaux. Even lower concentrations of both materials would probably be effective. Coverage of lower leaf surface is absolutely essential. The entire program of control is too detailed to give here. The indexing method developed here for obtaining Verticillium-free clones of chrysanthemum stock plants has continued to give satisfactory results. (A. W. Dimock)

PENNSYLVANIA: Leaf nematodes and wilt were present in greenhouses in the southeastern part of the State. Leafspots caused by Cylindosporium chrysanthemi and Cercospora chrysanthemi were more common than usual. (R. S. Kirby)

DELPHINIUM CROWN ROT (Sclerotium delphinii)

MARYLAND: Crown rot is very destructive each year on delphiniums in Maryland. Crop rotation aids some in its control. Soil with good drainage and lacking organic matter is less likely to produce this disease. (E. A. Walker)

NEW YORK: Crown rot and other organisms were severe due to excessive moisture. (A. W. Dimock)

PENNSYLVANIA: Crown rot is the most destructive disease on delphiniums in this State. (R. S. Kirby)

GARDENIA ROOTKNOT (*Heterodera marioni*)

NEW JERSEY: Gardenias, roses, and several other greenhouse plants showed heavy infestation of the root knot nematode in some establishments. Steam sterilization and chloropicrin are recommended in New Jersey, but both methods have their shortcomings. A new product, Sani-Grow, is available, which the manufacturer claims can destroy nematodes in growing gardenia plants. Thus far this writer has been unable to substantiate these claims. (P. P. Pirone)

ORNAMENTALS DAMPING-OFF (Several fungi)

NEW JERSEY: Damping-off occurs on all seedlings. Exact losses are difficult to estimate but complete failure of certain lots of seedlings is not uncommon. Heretofore some form of heat or any one of several chemicals have been recommended either to disinfest the soil or to coat seeds. An excellent substitute (which appears to be even more effective than most of the standard treatments) is to sow seeds on sifted, moistened sphagnum as suggested by Hope, Stoutmyer, and Close of the U. S. Department of Agriculture. Their method has been used by several New Jersey nurserymen and florists this year and was found to give almost perfect control of damping-off. This method might well be extended to vegetable and other food crops started in flats indoors. (P. P. Pirone)

PHLOX

NEW YORK: Leafspot (*Septoria phlogis* and/or *S. divaricata*) was severe in most plantings because of excessive rainfall. (A. W. Dimock)

POINSETTIAS

NEW YORK: Bacterial canker (*Corynebacterium poinsettiae*) was noted causing considerable damage in a number of cases. (A. W. Dimock)

ROSE BLACKSPOT (*Diplocarpon rosae*)
MILDEW (*Sphaerotheca pannosa* var. *rosae*)

MARYLAND: Blackspot appeared on greenhouse and garden roses that were not sprayed or dusted, following the rainy periods in July and August, causing leaves to drop early and thus reduce the vigor of the plants. Control -- Dust with sulfur-copper dust 90-10 at 10-day intervals or following rains. Plant recommended varieties resistant to blackspot. (E. A. Walker)

NEW JERSEY: Blackspot continued to be the most prevalent leaf disease of the rose. The sulfur-copper mixture developed by E. W. Lyle in

Texas appears to control blackspot in New Jersey as well as it does in Texas. Dr. Lyle estimated that 20 lbs. of this 90-10 mixture is sufficient for 100 rose bushes for a season (1 lb. per 100 bu. at each application). He suggests that the plants be dusted within 24 hours after each rain. One commercial rose grower in New Jersey was able to control blackspot almost perfectly by weekly dustings. This, in spite of the fact that heretofore little control was obtained with several other materials, and that 1942 weather conditions were ideal for blackspot development. (P. P. Pirone)

NEW YORK: Blackspot was unusually severe in many localities both out of doors and under glass. Mildew was locally severe, but no more so than usual. (A. W. Dimock)

PENNSYLVANIA: Blackspot and mildew were more severe than for many years. Blackspot is the most destructive disease of roses. Its control has resulted in twice as many plants surviving the winter as where the disease was unchecked. Three-year trials gave best control on Bordeaux-sprayed plants, and second-best control on plants dusted with a dust containing 5% copper and 20% sulfur. A 80-10-10 sulfur, lead arsenate, lime dust rated third but under most conditions is effective enough for most home gardeners. (R. S. Kirby)

SNAPDRAGON - RUST (Puccinia antirrhini), POWDERY MILDEW (Oidium sp.)

MARYLAND: Rust appeared to be very destructive in many greenhouses and some outdoor plantings. Control -- Suggest light application of sulfur dust at frequent intervals before blossom period. Select disease-free cutting stocks. Some varieties have been produced that are resistant to rust in other States. (E. A. Walker)

NEW YORK: Powdery mildew was frequently encountered on glass-house snaps last winter. Rust in greenhouses was controlled by Fermate at concentrations from 1 lb. per 100 gals. down to 1/8 lb. per 100 gals. with very little decrease in control at lowest concentration. Fungisul at 1 lb. per 100 gals. also gave excellent control; lower concentrations were not tested. (A. W. Dimock)

PENNSYLVANIA: Mildew was observed in a number of greenhouses in Pennsylvania. (R. S. Kirby)

TURF (Golf) - LARGE BROWN PATCH (Rhizoctonia solani)
SMALL BROWN PATCH (Sclerotinia homoeocarpa)

PENNSYLVANIA: Large patch was spasmodically present this season particularly on greens in warm locations with poor air drainage. Control -- 10 lbs. of hydrated lime per 1000 sq. ft. applied every 2 weeks gave superior control over Spergon 3 oz. or 6 oz.; Thiosan 4-1/2 oz.; Calochlor 3 oz. or Semesan 4-1/2 oz.

Small patch was unusually severe during 1942. Control -- Thiosan 4-1/2 oz. to 6 oz. per 1000 sq. ft. applied every 2 weeks gave control almost as good as Calochlor at 3 oz. per 1000 and was better than Special Semesan at 3 to 4 oz. or 6 oz. per 1000. (C. C. Wernham)

ZINNIAS

NEW YORK: Alternaria disease (Alternaria zinniae) was severe and increasing in range. (A. W. Dimock)

POTATO

POTATO BACTERIAL RING ROT (Corynebacterium sepedonicum)

MARYLAND: Ring rot has not been reported from Maryland. (E. A. Walker)

NEW JERSEY: Very few cases of ring rot were reported this year. One car of seed brought into the State was discovered to contain infected potatoes and was subsequently sold as table stock. Two cases of ring rot were found in our late crop seed. (J. C. Campbell)

PENNSYLVANIA: Occurrence was general, even in seed-producing areas. Table stock yields were only slightly reduced (3%); however, losses were high (25%) in some instances. Control -- A general improvement in the amount of ring rot from certified seed was noted although numerous instances of its occurrence in such stock can still be found. A rather high percentage of failures were noted in attempts to "clean-up" farms having ring rot in 1941. Evidence of resistance in any of commonly used varieties was lacking. (C. D. Burke)

WEST VIRGINIA: Ring rot is definitely on the increase in West Virginia. No cases of excessive loss, however, were called to our attention in 1942. There was considerable soft rot in some fields that apparently was not associated with ring rot. (J. G. Leach)

POTATO BLACKLEG (Erwinia phytophthora)

MARYLAND: Found general in lower parts of field where air and soil drainage is poor. The disease is coming in on certified seed each year. Estimated loss -- About 1% of tubers infected. Control -- Use certified seed potatoes. (R. A. Jehle)

NEW JERSEY: No cases of blackleg were reported. (J. C. Campbell)

PENNSYLVANIA: Occurrence general, loss low, 0.5%, since most affected plants died early. Control -- Home-grown seed from certified in 1941 were relatively free of this disease since affected plants usually die before reproducing in Pennsylvania. (C. D. Burke)

WEST VIRGINIA: Although the weather conditions were favorable for blackleg no unusual amounts of the disease were observed. The amount of soft rot observed in tubers at harvest time would indicate that the disease may have been more prevalent than our records indicate. Because of the frequent rains there was some loss in certain varieties caused by bacterial soft rot of the tubers. (J. G. Leach)

POTATO EARLY OR ALTERNARIA BLIGHT (Alternaria solani)

MARYLAND: Early blight was more general than usual although it developed late in early crops following a prolonged rainy period. The late crop was so badly affected with late blight that symptoms of early blight were hard to detect. Estimated loss -- About 1%. Control -- Keep plants healthy by proper cultural methods and spraying. (R. A. Jehle)

NEW JERSEY: Early blight was practically of no importance on the commercial crop. Slight to moderate infection occurred on the late crop but was not of economic importance. (J. C. Campbell)

PENNSYLVANIA: Early blight was more general than in any past year on record, however, losses were negligible. Observations on control were too meager to make a statement on their efficacy. (O. D. Burke)

WEST VIRGINIA: Early blight was more prevalent than usual as would be expected in a wet year. In most cases late blight made it impossible to determine the amount of damage, since it completely obscured early blight before the latter disease had reached its peak. (J. G. Leach)

POTATO LATE BLIGHT (Phytophthora infestans)

MARYLAND: Late potatoes grown for home use were so badly diseased that most growers did not continue to dig their crop after seeing the rotten tubers in the first few rows dug. Commercial late potato growers suffered great loss where spraying was not done frequently enough. Reducing the copper in the Bordeaux mixture spray was disastrous and cannot be recommended in a severe late blight year. Poorly sprayed potato vines were comparatively free from late blight but tubers rotted worse than on unsprayed vines. In unsprayed fields the vines died early and did not serve as a supply of fresh spores to inoculate tubers with each rain. Estimated loss -- Much higher in 1942 than previous year. At elevation of from 2000 - 3000 ft. 50%, and from tidewater to 2000 ft., 20%. Early crop not seriously affected and loss was less than 20%. Control -- Spray with Bordeaux mixture 4-6-100 at 7- to 10-day intervals beginning when plants are about 7 inches high and make 7 to 10 applications. This will control the disease even in severe years. (R. A. Jehle)

NEW JERSEY; Late blight caused no injury to early varieties; slight damage to foliage but almost none to tubers in unsprayed fields of late varieties of the commercial crop. Severe injury was caused on the second crop (planted for seed purposes about the first of August), especially in non-sprayed fields. Losses ranged from a trace to complete destruction. Adequate coverage with Bordeaux gave excellent control. (J. C. Campbell)

NEW YORK: In 1938 this disease was estimated to have caused a loss of 45%, in 1940 of 25%. Conditions this year seemingly have been more favorable for blight than in either of the earlier years, yet losses probably won't exceed 15%. The total production of potatoes in all 3 years was approximately normal as was also the case in the years of larger losses. The

reasons why production has been maintained in the face of epidemic conditions are 2. In the first place, and to an increasing extent, commercial acreages of potatoes are being protected by spraying with Bordeaux mixture. In the second place, the same weather conditions which bring about blight epidemics also bring about high yields. If similar conditions should prevail in 1943 and if the shortage of copper should prevent commercial growers from spraying, we may expect potato production in the State to be cut one-half or more. (K. H. Fernow)

PENNSYLVANIA: Late blight appeared early in 1942, being observed by June 13, and was present in every county in the State by the middle of July, causing severe defoliation, especially in the Mountain Counties. The disease has caused less tuber rot than would have been expected, owing probably to a dry period starting toward the last of August. Unsprayed fields were destroyed. Estimated loss -- Reduction of 23% from usual yields. Control -- Spraying when started early and repeated at 6- to 7-day intervals gave fairly good control but did not entirely prevent blight appearing in low spots in fields. Cutting strength of Bordeaux below 8-8-100 and using substitute materials was disastrous. Blight caused serious losses in dusted fields. (O. D. Burke)

WEST VIRGINIA: Late blight was very prevalent in West Virginia. It was first observed in late June and caused severe injury throughout the State. It did considerable damage in fields that were sprayed but, where spraying was most efficient, injury was delayed until early varieties had matured. In one experimental field dusting gave almost as good control as spraying. In this field the strength of the copper in the dust was reduced progressively; reducing the strength of copper one-half did not result in a significant decrease in yield as compared with full strength. (J. G. Leach)

POTATO PURPLE TOP WILT (Virus)

MARYLAND: This disease is not common in the Coastal Plain potato producing area and has not caused any appreciable loss in the western part of the State where it has been present for several years. (R. A. Jehle)

NEW JERSEY: Purple top wilt was not prevalent this year; no cases were reported. It was severe in some Katahdin plantings in 1941. (J. C. Campbell)

PENNSYLVANIA: Occurrence of purple top was much less common than in past years, however, York County had losses up to 50% of the tubers and every planting showed the disease. In other counties very little loss could be noted. Control -- Early varieties escaped infection and Katahdin and Sebago expressed only mild symptoms. (O. D. Burke)

WEST VIRGINIA: This disease apparently was less prevalent than it has been in past years although in some local areas as many as 50% of the plants were affected. As in past years the earliest varieties escaped severe injury. (J. G. Leach)

POTATO RHIZOCTONIA (Rhizoctonia solani)

MARYLAND: Rhizoctonia was slightly more abundant than last year. The wet early season may have caused some increase. Estimated loss -- About 3%. Control -- Plant potatoes on well drained soil. Practice at least a three year rotation. (R. A. Jehle)

NEW JERSEY: Very limited observations were made but it is believed that occurrence of Rhizoctonia was slightly greater than usual. The general dry conditions during April and May delayed germination and several fields showed very poor stands, especially on knolls and light soil types where potatoes may have been planted too deep. (J. C. Campbell)

PENNSYLVANIA: Occurrence was general and losses average 4% owing mainly to wet, cool, and poor growing weather early in the season (planting time). Control measures were not generally practiced since the disease usually causes very little trouble. (C. D. Burke)

WEST VIRGINIA: No extensive observations were made on the presence of Rhizoctonia. In a normal year it does not cause much damage. Seed treatment experiments conducted in several areas showed no benefits indicating that the disease probably did not do much damage. (J. G. Leach)

POTATO SCAB (Actinomyces scabies)

MARYLAND: Potato scab was more prevalent in 1942 than in the previous year. Heavily limed soils resulted in more scab than acid soils. Estimated loss -- 6% in 1942 and only 5% in 1941. Control -- If scabby potatoes must be planted select those with only shallow scab and treat seed with Improved Semesan Bel or other recommended treatment. Avoid liming potato land unless it is very acid. (R. A. Jehle)

NEW JERSEY: Very little damage is caused by scab since most growers plant on soils of low pH. A few local areas were reported but treatment with sulfur usually controls the disease very readily. (J. C. Campbell)

PENNSYLVANIA: Occurrence was general, and losses 1%; severe only on limed soils. Control -- No serious outbreaks on soil at pH5. However, one area with soil of limestone origin testing pH7 or more shows no scab excepting where liming has been practiced. (C. D. Burke)

WEST VIRGINIA: Very little scab was observed. Because of the general high acidity in the soils of this State scab is not very prevalent. However, it has been observed causing heavy infection in certain local areas. (J. G. Leach)

POTATO VIRUS DISEASES

MARYLAND: Yellow dwarf was present to about same degree as in former years. Mosaic is present to a small extent in the Coastal Plain area. There is a tendency for mosaic in the mountain region at elevations over 2000 ft. Leafroll appeared to be increasing this year over 1941 and there

was little difference between the amount of the disease at low or high altitudes in the State.

	Percent Loss	
Disease	Elevation Tidewater to 2000 ft.	Elevation 2000 to 3000 ft.
Yellow dwarf	Trace	Trace
Mosaic	1.5	0.5
Leafroll	3.0	3.0
Spindle-tuber	0.5	0.5

Control -- Careful roguing of seed plots. Prefer tuber-unit planting methods, combined with careful field inspection and roguing. (R. A. Jehle)

NEW JERSEY: No increase in virus diseases was evident. As usual, some few lots of certified seed contained 20 to 30% leafroll. The other viruses were not of any importance. Since over 85% of all seed used in the State is certified, the losses from viruses are slight. (J. C. Campbell)

What appears to be an undescribed disease, virus in nature, was observed in 4 potato fields in Central Jersey this year. This disturbance was reported in the August issue of HINTS TO POTATO GROWERS, Vol. 23, No. 4. Some of the symptoms of the affected plants are a shortening of the internodes, and a reduction of the angle between the petiole and stem, especially at the top of the plants. There also occurs a mild thickening of the main stem of the plant. Together with the shortening of the stems, many buds that normally remain dormant are stimulated into activity so that one shoot, or sometimes more, arises at each of most of the nodes. This abnormal shoot production gives the plant a very compact, leafy appearance. The affected plants examined have also exhibited a large number of small leaves, particularly at the top of the plant. These leaves often exhibit a mosaic pattern of yellowish and greenish spots. Cupping or rolling of the leaves is common symptom. Badly affected plants are usually smaller than the neighboring healthy plants. Where the symptoms are not so pronounced the affected plant can usually be first observed by its somewhat broader and more compact tops. (R. H. Daines)

NEW YORK: Normal incidence of leafroll in New York potato fields is probably about 5 or 6% with losses averaging around 2%. The low incidence is due to the fact that in portions of the State where leafroll spreads rapidly it is customary to replace seed each year or two with certified seed. In 1942 samples of about 50 lots of Long Island home-grown seed were treated in Florida. This seed showed an average of 46% leafroll. Some lots of certified seed also showed high percentage but could be discarded because of the test thus keeping the losses due to leafroll to about 3% of the crop. (K. H. Fernow)

PENNSYLVANIA: Leafroll, mosaic, and yellow dwarf on stock planted from certified seed were generally too high indicating that certification authorities can and should look toward the tightening of regulations. (C. D. Burke)

WEST VIRGINIA: The virus disease situation was about normal. No significant increase or decrease was observed in amount of infection. It varies according to the source of the seed stock. (J. G. Leach)

POTATO WILT (Fusarium eumartii)

MARYLAND: Wilt was less severe in 1942 than usual in all parts of the State. The small loss probably resulted from abundant and well distributed rainfall in the potato-growing regions. The disease was more prevalent in the Eastern Shore early crop where hot dry weather prevailed during the early summer months. Estimated loss -- About 1%. Control -- Use better cultural practices to conserve moisture and grow strong healthy plants. Use best seed obtainable and practice at least three year rotations. (R. A. Jehle)

TOBACCO

TOBACCO ANTHRACNOSE (Colletotrichum sp. or Gloeosporium sp.)

MARYLAND: Anthracnose appeared in the greenhouse on May 7 and in farmers' seedbeds on May 15, as a general infection over the tobacco growing area. The disease spreads rapidly during wet weather and is most severe in low, poorly drained bed land. Small seedling plants are killed; larger seedlings show leaves with thin, sunken, ashen-gray spots with brownish borders; lateral veins brown to cause a spinach-like appearance; midrib and stalk have numerous oblong sunken greenish-brown lesions. The disease was found in the field during 1942, persisting on leaves, midrib, stalk, and flower head. It was severe in low wet land. It has been common for the past 2 years in Maryland, but was unreported elsewhere. Estimated loss -- Reduction in number of plants in seedbed about 5%. Total loss in some sections. Loss in field negligible in Maryland cigarette-type tobacco. Control -- No definite seedbed control recommended. Suggest spraying seed beds with Bordeaux mixture 4-6-50 at 10-day intervals beginning just after plants emerge from ground. Four percent Spergon has reduced infection in greenhouse. Clean tobacco seed and treat with Ceresan. (E. A. Walker)

PENNSYLVANIA: Anthracnose was observed on a few plants in 3 beds on June 12, 1942. Because of the widespread occurrence of blue mold this disease was difficult to determine. (C. D. Burke)

TOBACCO BLUE MOLD [downy mildew] (Peronospora tabacina)

MARYLAND: Blue mold is a destructive plantbed disease. Early-affected plants have yellowish puckered leaves usually cupped with tip and margin turning downward. Badly affected leaves have scorched appearance.

Blue mold first appeared on May 4, somewhat later than usual. Spreading rapidly, it became destructive to plant beds following rains on May 21 to 23. The disease was light this year although it was continuous in untreated beds and delayed transplanting about 10 days in some sections in spite of the dry season. Late beds face greater danger from blue mold than early beds do because the plants are smaller at the time blue mold strikes most severely. Large plants recover in 10 days; small plants are killed or stunted. Badly infected beds have the odor of decomposed wet vegetable matter. The disease was not reported in the field. Estimated loss -- Reduction of 5 to 15% in young plants in bed and delay of 10 days in transplanting. Control -- Increased number of growers are using paradichlorobenzene crystal gas treatment as a cure at a rate of 1-1/2 to 2 lbs. per 100 sq. yds. of bed area on 2 successive nights at 5- to 7-day intervals. Spraying the beds twice weekly with 7 to 8 applications beginning 10 days before blue mold appears is an excellent preventative. Cuprous oxide 1/2 lb., cotton seed-oil, 2 quarts, and water 50 gals., ferric-dimethyl-dithio-carbamate (Fermate), or bismuth sub-salicylate 1-1/2 lbs., Vatsol C.T.C. (sodium dioctyl sulfosuccinate) 1 lb., water 100 gals. are good spray materials to use for blue mold control. (E. A. Walker)

PENNSYLVANIA: Blue mold was observable in most seed beds, varying from a trace to moderate attack. The first appearance was on May 8 with more serious attack after May 15. Some young plants were killed while leaves on older plants were destroyed but buds undamaged. Recovery followed in 10 days. Early plants were often pulled before the disease became severe. Estimated loss -- Delay of about 10 days in transplanting occurred in some cases. There was about 10 to 15% loss in killed plants, but an actual shortage of plants was rare. Control -- Measures for control were applied in a small proportion of cases with the use of paradichlorobenzene. Some experimental tests of ferric-dimethyl-dithio-carbamate (Fermate) using 1-1/2 lbs. to 100 gals. gave results indicating that this spray might become an effective method of control. (W. S. Beach - C. E. Street)

TOBACCO HOUSEBURN (Various fungi)

MARYLAND: This is a common deterioration disease with air-cured tobacco. It was worse in 1942 than usual because of high air humidity during harvest, and crowding of barns on account of rapid ripening of the crop in the field. Application of heat was generally used too late to save crop. Leaves, petiole, and stalk were affected. Diseased leaves are dark brown to black in color, crumble easily when dry, and have no market value. A musty odor emanates from the diseased leaves when stored. Houseburn occurs after the leaves have yellowed and before they are cured. Estimated loss -- From 15 to 20% of crop was damaged in 1942 with further loss expected in the stripped and packed tobacco if handled too wet. Control -- Use pit or stove heat in curing barns during critical houseburn weather. Open barns to increase circulation during drying weather. Maintain at least 6°F. difference between wet- and dry-bulb thermometer readings. (E. A. Walker)

PENNSYLVANIA: Houseburn was uncommonly prevalent in 1942 on 30% of the crops harvested during cloudy weather before August 20, but later harvested crops were not damaged. Some crops went into the barns with leaves and stalks full of water and only slightly wilted. Timely use of heat saved a small percentage of crops from deterioration but many farmers were not equipped or prepared for the unusual situation. Estimated loss -- Ranged from 25 to 50% on early, 10 to 15% on medium, and none on later harvested tobacco. Additional losses will be observed after the crop is stripped. Control -- Apply heat to barns during unfavorable weather. Use of fires is not practical in barns used for housing straw, hay, corn-fodder, livestock, machinery etc. Preliminary wilting on frames or scaffolds is practicable. Less crowding on lath and in shed with more adequate ventilation is recommended. There will be some shortage of charcoal fuel during war. (O. E. Street, and W. S. Beach)

TOBACCO MOSAIC, VIRUS (*Marmor tabaci* var. *vulgare*)

MARYLAND: Mosaic is usually a field disease, but is sometimes found in the plant bed. It was abundant in 1942, but most severe in 1941. Isolated plants in the field showed infection 10 days after the transplanting. It was spread rapidly by cultivation, hoeing, etc., and after topping suckers become badly infected. During the last 2 years a large amount of mosaic appeared after heavy rains, indicating a possible relationship between nitrogen deficiency and increased virus symptoms. Early affected plants are dwarfed. Affected leaves show mottled yellowish-green and dark-green areas that may become puckered. On hot days the leaves may become necrotic or show dead areas. The disease is spread by workmen through careless handling of the previous season's diseased crop or use of diseased tobacco while working with the growing crop. Estimated loss -- About 8 to 10% of crop leaves are damaged resulting in poor quality when cured. About 40% of suckers have mosaic, which causes no commercial damage. Control -- Rogue out diseased plants. Top diseased plants last. Use field and seed bed sanitation. Furnish laborers with sterilized tobacco instead of letting them use virus-bearing tobacco for chewing and smoking. Resistant types are being derived from Ambalema tobacco. (E. A. Walker)

PENNSYLVANIA: Mosaic had average prevalence in 1942. Seed bed infection is occasional and this results in a high percentage of field disease. Cigar smoking sometimes results in occurrence above the average. Native weed carriers and carry-over in the soil probably are factors in less extensive cases. The disease is spread some by cultivation, hoeing, and worming, but more by topping and suckering. Loss consists of stunting and necrotic spotting (mosaic rust) following hot days in the case of early infection. Sucker infection is not detrimental as development is too late. Estimated loss -- About 5% on account of small size, low weight and poor curing of leaves, as well as by necrotic spotting. Control -- Some growers understand how mosaic is spread and practice sanitation. Seed beds are earlier than most vegetation and tend to escape infection from wild carrier plants. Use of native leaf by growers is not common. (W. S. Beach and O. E. Street)

TOBACCO WILDFIRE (Pseudomonas tabaci)

MARYLAND: Wildfire appeared in tobacco plant beds later this year than usual. The plants were large enough to transplant when most severe attack came. A large number of plants had systemic infection. Diseased plants set out in the field spread wildfire so that field infection as blackfire was very severe at topping time following water-soaking of leaves with the unusually heavy rainfall. Regular spraying of plant beds with Bordeaux mixture (4-6-50) at least 3 times during early growth of seedlings prevents appearance of the disease in the beds. Estimated loss -- In plant bed about 3 to 4%. In field as blackfire about 10 to 12%. Control -- Spray with Bordeaux mixture (4-6-50) beginning when plants are all well germinated and through the ground. Continue at 10-day intervals until 3 to 4 applications are made. Spray the cotton covers and side boards as well as the plants. Avoid bruising of plants, chewing of home grown tobacco, and practice general seed bed sanitation. (E. A. Walker)

PENNSYLVANIA: In recent years, wildfire has occurred in a great majority of seed beds, but in 1942 prevalence was less than usual. Beds properly sprayed with Bordeaux had few or no symptoms. From transplanting to mid-August, rainfall was frequent and much above normal. Early crops exhibited extensive spotting with the higher or top leaves affected. The spots, however, were of the halo type, not great in diameter and seldom coalesced, hence damage was low in proportion to the number of infections. On late crops, spotting was less and confined more to lower leaves. Indications are that the crop, in general, has very good burning quality, tending to off-set leaf spot damage. Estimated loss -- About 10% in unsprayed plant beds. In field about 15 to 25% on early and medium planted crop, and about 3 to 8% on late planted crop. Firing due to potash deficiency was less than usual. Field infection was abundant in the wet season. About 75% of the field damage was not traceable to seed bed infection. Control -- Spray plant beds early and thoroughly with Bordeaux mixture, commencing not later than the seed-leaf stage or seedling growth. Addition of side dressings of potash fertilizer in bed and field aid in better control of wildfire. (W. S. Beach and C. E. Street)

TRUCK CROPS

TRUCK CROPS - DAMPING-OFF

WEST VIRGINIA: During the spring of 1942 we started a survey of organic materials which might be used as substitutes for copper and mercury salts. In tests, tetramethyl thiuram-disulphide at 80% concentration (Japanese beetle spray) and ferric dimethyl-dithio-carbamate (Fermate) showed considerable promise as seed protectants. In later tests Thiosan (50% tetramethyl thiuramdisulphide) was included. These tests were conducted in greenhouse loam soil at pH values of 5.2 to 5.4. High soil moistures were maintained. At the beginning of the tests Pythium sp. was introduced into the soil as inoculum. Isolations from damped-off plants

yielded Pythium sp. In preliminary trials beneficial results were obtained on cabbage, carrot, cantaloup, peas, spinach, tomato, and sweet corn; both materials being at least as good as Cuprocide.

In later trials on spinach, dosages as low as 0.1% by weight of these materials were more effective than either Cuprocide or zinc oxide at 2% in preventing pre-emergence damping-off. With both Thiosan and Fermate protection increased with increasing dosages until the maximum possible adherence load was reached. It is believed that dosages of from 0.5 to 1.0% will be most efficient in offering protection and conserving materials.

Equally favorable results have been obtained with cabbage, both Thiosan and Fermate at 1.0% proving superior to Cuprocide, zinc oxide, Semesan, or Spergon at recommended rates.

There was some evidence of injury on lettuce as indicated by reductions in emergence. At maximum adherence loads emergence was delayed and the final stand was reduced. Reduction in dosage resulted in increased stand. However, in no case did stands of lettuce with either of these materials equal those obtained with Cuprocide at 2%. (C. F. Taylor)

ASPARAGUS RUST (Puccinia asparagi)

NEW YORK: In 1942 only one heavily infested field was found. Traces occurred in a small number of other plantings. Where only the Washington varieties are planted, and the stock procured from seedsmen who lately have tested for rust-resistance, there is almost none of the disease. It was absent from the State until the Paradise variety was introduced. This strain not only was extremely susceptible but seemed to carry the inoculum with it. The last field of these plantings is being plowed under, and we hope the rust will again disappear. (Charles Chupp)

BEAN ANTHRACNOSE (Colletotrichum lindemuthianum)

MARYLAND: Bean anthracnose was destructive locally in home gardens and victory gardens, but did not cause any appreciable loss in commercial plantings. (C. E. Cox)

NEW JERSEY: There was more in 1942 than in recent years but it caused very little loss. The disease has disappeared as an important bean problem since western-grown seeds are generally used. (C. M. Haenseler)

NEW YORK: After many years of almost complete absence of bean anthracnose from New York State, it appeared in almost epidemic form in 1942. The actual sale loss of one grower was $15,000 and of another, over $50,000. Because of the difficulty in procuring seed from the Twin Falls area (Idaho) and since much of the western seed is heavily infected with mosaic, more and more eastern-grown seed was planted. During the "thirties" most of the seasons were dry enough so that Colletotrichum did not multiply. But 1942 being a wet year, the disease spread rapidly, and in some cases destroyed whole fields completely. Rarely, the seedsman insisted that he handled only western-grown stock. In every instance, however, where anthracnose appeared in epidemic form, we were also able to prove that it was eastern seed. (Charles Chupp)

PENNSYLVANIA: Anthracnose was the most widespread and destructive that it has been for many years. Commercial bean growers had their greatest difficulty in September. The average State loss was about 3%. Control -- Clean seed was important. Several growers reduced the amount of pod spotting by applying Bordeaux in the field. (R. S. Kirby)

BEAN BACTERIAL BLIGHT AND HALO BLIGHT (*Xanthomonas phaseoli* and *Pseudomonas medicaginis* var. *phaseolicola*)

MARYLAND: Bacterial blight of bean was generally less severe in 1942 than in 1941. The diseased fields observed were all planted from a single lot of seed reported to be of western origin. Estimated loss -- About 5% in lower Eastern Shore country. No appreciable loss in remainder of State. Control -- Use western grown seed free from disease. (C. E. Cox)

NEW JERSEY: Bacterial blight determined as due to *Xanthomonas phaseoli* caused more serious trouble on Fordhook Lima beans in 1942 than for many years past. A few fields in southern New Jersey were almost totally destroyed by August 10 and others showed 10 to 30% loss due to both foliage and pod infection. Abundant rainfall and high humidity favored the development of the blight this year but infection of seed lots was apparently responsible for the local distribution of the disease. Green beans this year showed little bacterial blight although in other years heavy losses have been experienced in certain fields evidently planted with infected seed. No data on seed sources have been obtained in most cases of blight outbreaks but the appearance of the disease in local fields emphasizes the importance of infected seed lots and the need for some system of bean seed certification which would guarantee blight-free seed. (C. M. Haenseler)

WEST VIRGINIA: Observations were not sufficient for making an accurate estimate. (J. G. Leach)

BEAN TIMBER ROT (*Sclerotinia sclerotiorum*)

NEW JERSEY: Of no importance. (C. M. Haenseler)

NEW YORK: Timber rot has been common and destructive in many bean fields during 1942. The wet weather no doubt is responsible. Dr. H. S. Cunningham at the Riverhead Experiment Station reports one field of Lima beans with 80% infection. The Limas followed a spring crop of peas which also were infected. (Charles Chupp)

PENNSYLVANIA: Occurrence reported only in Bradford county, loss a trace. (H. Bauer)

WEST VIRGINIA: None reported in 1942. (J. G. Leach)

BEAN (LIMA) MOSAIC (Virus)

NEW YORK: The vines of a small planting of lima beans at Geneva were heavily infected with cucumber virus 1. The inoculum came from an adjoining experimental planting of various mints. The disease is very destructive to limas. (Charles Chupp)

CABBAGE ALTERNARIA LEAFSPOT (Alternaria circinans)

NEW JERSEY: More in 1942 than usual but of little economic importance except in occasional late plantings and in very susceptible varieties. Several years ago Harris Ball Head was almost a total loss due to alternaria leafspot in one field where other varieties planted in adjoining rows were only slightly affected. Inoculation tests indicated that Harris Ball Head is much more susceptible than Danish Ballhead, Short Stem (Harris) and Midseason Market (Harris). Seed treatment with hot water 122°F for 25 minutes has controlled very successfully alternaria spot on cotyledons and hypocotyl of seedlings but no effort has been made to control the disease in the field. (C. M. Haenseler)

PENNSYLVANIA: Leafspot was the most destructive cabbage disease this year. The pathogen caused heavy losses in the northwestern part of the State following numerous fall rains. Some fields were so badly diseased that no cabbage was harvested. For the State as a whole there was a loss of at least 15% of the fall crop. The loss in early and midseason cabbage was insignificant. Control -- Treat seed with hot water (122°F) for 25 minutes and follow a rotation of 4 years between cabbage crops. The disease may be checked in wet years by spraying with 8-8-100 Bordeaux mixture plus 1 pound of calcium caseinate. (O. S. Cannon)

WEST VIRGINIA: No observations. (J. G. Leach)

CABBAGE BACTERIAL SOFT ROT (Erwinia carotovora)

NEW YORK: The bacterial soft rot of cabbage was far more destructive in 1942 than during the average season. Nearly every rainfall was accompanied by high temperatures. In addition, lack of labor resulted in much later cultivation than usual. When the leaves were large and succulent, the cultivating tools broke many of them. Infection followed almost every injury. In at least 2 fields there was as much as 40% loss of heads. (Charles Chupp)

CUCURBIT ANTHRACNOSE (Colletotrichum lagenarium)

DELAWARE: Anthracnose was much more prevalent in 1942 owing to the favorable weather conditions of mid summer. Complete destruction took place in a few days in some plantings. Average losses were low. (S. L. Hopperstead)

NEW JERSEY: No more severe than usual in 1942. Foliage in well-sprayed fields remained in good condition throughout the season. (C. M. Haenseler)

NEW YORK: The high temperatures that usually accompanied the rains in 1942 were favorable for the spread of this disease. Where spraying or dusting was not well done, the cucumber and muskmelon crops were killed in the middle of the season. Because of the sudden destruction of entire fields, farmers referred to the trouble as "fire" or "frost". (Charles Chupp)

PENNSYLVANIA: Above-normal rainfall from July to September enabled this disease to be unusually destructive. The average State loss was about 5%. Spraying and dusting reduced loss. (R. S. Kirby and A. H. Bauer)

WEST VIRGINIA: No observations made in 1942. None reported to Department of Plant Pathology. (J. G. Leach)

CUCURBIT MOSAIC (Cucumber Virus 1)

NEW YORK: Cucurbit mosaic occurred in epidemic form even though the insect vectors were supposed to be less common than usual. Three experimental cucumber plots were isolated from weeds and other cucurbits. One plot was in the center of a closely mown meadow and remained free from mosaic. The other 2 plots were each in the center of a soybean field free of weeds. These cucumbers were heavily infected. There is some indication that this soybean virus was cucumber virus 1. (Charles Chupp)

PEA SEED DECAY (Several soil fungi)

NEW JERSEY: Spergon and Thiosan have given slightly better control of seed decay than red copper oxide in several test plots but red copper oxide was used on a large scale with good results in commercial plantings. (C. M. Haenseler)

PENNSYLVANIA: About 20% of the pea seed planted in Pennsylvania in 1942 failed to grow because of seed decay. Control -- At demonstrations conducted on 11 different farms an average stand increase of 22% was obtained by dusting seed with Spergon before planting. Yield data was obtained at 3 places. On these farms the average yield of shelled peas from an acre was 19% greater than the yield from untreated seeds. This was an average increase of 393 lbs. of shelled peas from an acre. At 6 places Spergon increased the stand 29% as compared with a 23% increase from Thiosan. At the 2 places where yields from these 2 materials were compared the yield increases were 25.4% for Spergon and 12% for Thiosan. (O. S. Cannon)

CORN (SWEET) BACTERIAL WILT (*Bacterium stewartii*)

MARYLAND: Stewart's disease is very destructive to our sweet corn used for canning since many susceptible varieties are still being grown. Among these may be mentioned Stowell's Evergreen, Shoepeg, and Golden Bantam. Golden Cross Bantam is replacing Golden Bantam for table use and

to some extent in the canning industry. It shows some blight which does not seriously affect the yield. Estimated loss -- About 2% for all varieties. Control -- Avoid early planting of susceptible varieties. Use resistant varieties. Suggest Golden Cross Bantam as a good yellow variety. (E. A. Walker)

NEW JERSEY: Bacterial wilt was probably slightly more prevalent in 1942 than in 1941. Golden Bantam showed 13% wilt at New Brunswick in 1942 on the same plot where it developed 5% wilt in 1941. In southern New Jersey wilt was very erratic in its distribution, being severe in one field and very slight in others. The average daily temperature during the winter months December, January, and February before the 1942 season was 33.7°F for the Burlington county area and 32.2°F for New Brunswick. These are close to the critical temperatures which in past years have been followed by "moderate amount of wilt". Our wilt-free years have usually been preceded by winters with average daily temperatures below 30°F and our very "severe wilt" years by winters with average daily temperatures of 35°F or higher. After winters with an average daily temperature of between 30° and 35°, as in 1942, the wilt is usually very localized in its occurrence. The only control attempted is to plant partially resistant hybrids. General use of such hybrids has greatly reduced losses from wilt. (C. M. Haenseler)

NEW YORK: Bacterial wilt was lacking almost entirely in New York State in 1942. The only report was a trace in one section of Nassau County, Long Island. The average mean temperature for the previous winter months was 27.4°F. This apparently is almost in the danger zone. In former years a small amount of wilt was found when the average temperature was 28.2°F. In the epidemic years of 1932 and 1933 the average temperatures were 32.7°, and 32.5°F, respectively. In addition to temperature it is necessary to have abundant inoculum for an epidemic. Since the inoculum has disappeared almost entirely, there is not much danger for 1943 even though the temperatures should average above 32°F. (Charles Chupp)

PENNSYLVANIA: Bacterial wilt was fairly common on susceptible varieties this year. One field of Golden Bantam in Philadelphia county had 35% wilt. Most of the sweet corn now grown in the State is of the resistant hybrid varieties and these had little or no wilt. First observed on June 19. Average loss was a trace. Control -- Planting the resistant hybrid varieties. (R. S. Kirby)

WEST VIRGINIA (See also under field corn, CEREAL CROPS): The disease was prevalent but no destructive outbreaks were observed. Leaf infections were often obscured by Helminthosporium leaf blight. (J. G. Leach)

SWEETPOTATO WILT, YELLOWS, SPLIT STEM (Fusarium batatatis)

DELAWARE: Wilt or yellows of sweetpotato has been severe in the little stem (Jersey types) this season, probably related to high heat in the seed beds, with high temperature and droughty conditions at time of setting and prior to setting. Estimated loss -- 25 to 50% of stand, with

an average of 35%. Control -- Most easily controlled by growing "slip seed", that is, stock grown from cuttings or "slips" consisting of vine clippings 12 to 14 inches long taken from healthy plants. Often the dipping of the sprouts (young plants) in disinfectants assist in control. Spergon gave better control this season than organic mercury or yellow copper oxide. (T. F. Manns)

TOMATO ANTHRACNOSE (*Colletotrichum phomoides*)

MARYLAND: Anthracnose made its appearance earlier this year than usual. The estimated average loss for the State from this disease was about 2%. This is only slightly above the estimated 5-year average of 1.7%. (C. E. Cox)

NEW JERSEY: Anthracnose was very destructive in many fields and particularly severe after plants had been partially defoliated by leaf blights. Observations have indicated that plants fed, sprayed, and otherwise handled so that they retained good foliage until the end of the season developed less anthracnose on the fruits. We have no evidence that the disease can be effectively controlled by sprays but where leaf blights and anthracnose are associated in the same field the losses from anthracnose seem to be appreciably reduced, probably indirectly, by the sprays. There is urgent need for more information on many phases of this very destructive disease. (C. M. Haenseler)

PENNSYLVANIA: Anthracnose was present in all parts of the State and was more destructive than for many years. The heaviest loss occurred in the southeastern and the northwestern parts. The disease was observed August 18 and the average State loss was 8%. Control -- Field rotation, clean plants, and wide spacing in the field are recommended. The abnormally wet July and August allowed the disease to become general under all growing conditions. Field spraying of tomatoes is not a general practice in this state. (R. S. Kirby, C. S. Cannon, A. H. Bauer, and G. L. Zundel)

WEST VIRGINIA: Few observations were made on anthracnose. The disease was present in most fields and contributed to fruit decay although most of the rot was due to Phytophthora rot. (J. G. Leach)

TOMATO ALTERNARIA CANKER AND LEAFSPOT (*Alternaria solani*)

DELAWARE: Alternaria canker and leaf spot was responsible for more damage than Septoria leaf spot during the 1942 season. The disease was most prevalent in the two northern counties. Estimated average losses were from 7.5 to 10%. Spraying and dusting when practiced gave excellent control. Fruit from sprayed or dusted plantings generally graded higher. (S. L. Hopperstead)

MARYLAND: Alternaria leafspot was widespread and during the height of the harvest season hardly a plant could be found that did not show some lesions. Very late planted tomatoes were less severely attacked than the main crop. The collar rot stage of the disease on seedlings was less severe

than in previous years. The dry weather early in the season apparently prevented its development; however, subsequent development of the leafspot occurred when rainfall was heavier indicating that abundant inoculum was present. Estimated loss -- The average loss was estimated at 5%. Control -- Field spraying for control of leafspot is not recommended in this State, as a profitable crop can ordinarily be harvested before defoliation becomes severe if healthy plants are transplanted to fields in which the fertility is maintained and a proper rotation practiced. (C. E. Cox)

NEW JERSEY: Canker was very severe in a few fields set with infected lots of southern-grown plants. A few fields required 25 to 50% replanting, while a few others were so severely cankered that they were plowed and reset or planted to another crop. The leaf blight phase of the disease was very prevalent during September and associated with Septoria and Stemphylium blights caused almost 100% defoliation in a large percentage of fields by the time half the crop was harvested. This is the first season that the Stemphylium leaf blight has been diagnosed here. Very severe anthracnose followed in many of the severely defoliated fields. Sprays gave only a partial and inadequate control of the leaf defoliation complex. (C. M. Haenseler)

NEW YORK: The Alternaria blight was fairly prevalent the past season. It caused at least 5% average loss, and in some fields almost defoliated the plants. Excellent results were obtained by spraying beginning about the middle of July. In a demonstrational way attempts were made to control the blight by 2 or more side dressings with nitrates, beginning just as the first fruits were forming. There was considerable evidence that where all other conditions for luxuriant growth were present, nitrate applications reduced the blight almost as much as did spraying. But in most fields, especially in the western part of the State, there were other malnutrition problems, and where these occurred, nitrates were of no value for blight control. (Charles Chupp)

PENNSYLVANIA: Alternaria canker and leafspot disease was present in every county. It was most severe in the northeast, less severe in center and northwest, and below average in the southwestern and southeastern parts of the State. The disease was first observed in the field on May 28. Estimated loss -- Average loss for the State was 10%. Control -- Plants produced from seed treated with mercury, grown in clean seedbed soil, sprayed in the seed and transplant beds with copper, and transplanted to fields having at least a 3-year rotation, produced crops having almost no disease until late in the season. Southern plants varied from clean to severely diseased. The disease increased in most southern plants, the amount varying according to the time they were held before planting. In one case part of a lot of plants later developed .5% disease when planted immediately on arrival and part of the same lot stored for 9 days developed 31% primary canker in the field. (R. S. Kirby, C. S. Cannon, A. H. Bauer, G. L. Zundel, and O. D. Burke)

WEST VIRGINIA: Alternaria leafspot was very prevalent throughout the State. In all the fields in which it was observed it was more prevalent and did more damage than Septoria leafspot. It was estimated that the loss from Alternaria and Septoria leafspots was approximately 10%. Some control was obtained in one field by spraying the plants with copper oxide and with Fermate. Spraying was started late, however, and control was only partial. It is believed that a spray program started early in the season would have been effective in controlling the disease. (J. G. Leach)

TOMATO BACTERIAL CANKER (Corynebacterium michiganense)

NEW JERSEY: This year canker was limited to a few farms where home-grown seed are used. Our strict adherence to the regulations that no field showing even a trace of bacterial canker be accepted for seed certification, we believe, has eliminated the canker problem from our principal source of plants which come from certified seed. Several tests have failed to indicate that bacterial canker overwinters in our field soils here, although planting tomatoes in a field where the disease occurred the previous year is discouraged. The major problem here is to clean up small farms where the use of home-grown infected seed and infested plant beds perpetuates the disease on an individual farm or in a local community. (C. M. Haenseler)

NEW YORK: One canning company imported from another State enough tomato plants to set 500 acres. Unfortunately they were infected with bacterial canker. A conservative estimate of the loss was $50 an acre or $25,000. Other companies imported a few plants from the same source. These together with some infection where rotations were not practiced brings the total loss in the State to approximately $30,000. It has been found that hot water seed treatment, clean seed beds, and 2-year rotations completely control the disease. It rarely is present any more in commercial fields. (Charles Chupp)

PENNSYLVANIA: Very few fields of tomatoes had even a trace of bacterial canker. Control -- Seed fermentation and hot water seed treatment combined with seed bed spraying and field rotation have almost completely driven the disease from the State. (R. S. Kirby)

WEST VIRGINIA: None observed. (J. G. Leach)

TOMATO BACTERIAL SPECK (Bacterium tomato)

NEW YORK: Specimens were sent to the Department from Chautauqua County. Our bacteriologist made the determination. The organism is Phytomonas tomato (Okabe) Magrou (syn. Bacterium punctulans Bryan). Apparently there was no appreciable loss. (Charles Chupp)

TOMATO LATE BLIGHT (Phytophthora infestans)

DELAWARE: Late blight was serious on tomatoes in New Castle County only and in a few plantings only. Plantings affected usually were in close

proximity to diseased potatoes. Average loss for the State was of no consequence. (S. L. Hopperstead)

MARYLAND: Phytophthora infestans was not observed on tomato foliage this year although potatoes were severely affected. There was an estimated 10% loss from fruit rots, chiefly buckeye rot caused by a species of Phytophthora, presumably P. terrestris [parasitica]. This disease was about as destructive on staked tomatoes in home gardens as on field-grown tomatoes. The unusually heavy rains apparently splashed the fungus from the soil to fruits rather high up on the vines. Buckeye rot is of little importance in the State in the ordinary season. (C. E. Cox)

NEW JERSEY: Never general and usually severe in only a very few fields. No increase observed in 1942. (C. M. Haenseler)

NEW YORK: Dr. Reddick states that tomatoes at the beginning of the late blight season are almost immune to the fungus as it appears on potatoes. One leaf only in an entire field of tomatoes may be attacked. The fungus, gaining virulence from this slight infection, attacks more foliage the second generation. The virulence then increases for at least 7 generations of the pathogen, after which it can attack tomatoes in epidemic form. That is what happened this season. The potato blight started early, and since the 7 generations of the fungus can occur in 35 days if the weather is favorable, it had ample time to build up its powers of infection. Until frost time it swept tomato fields almost as readily as it attacked potatoes. (Charles Chupp)

PENNSYLVANIA: Late blight for the first time in many years was observed in all sections of the State. In most areas infected fields were scattered, but in the northeastern part over 80% of the fields were infected. The disease was most destructive on tomatoes growing in the vicinity of blighted potato fields. In the southern part of the State it was usually found only in fields that were planted very late. The average State loss was 3% and the disease was first observed July 18. Control -- Spraying with 6-6-100 Bordeaux is an effective preventative measure. (R. S. Kirby, O. S. Cannon, G. L. Zundel, and A. H. Bauer)

WEST VIRGINIA: Late blight was present on tomatoes and caused some injury. There was also a great deal of rot caused by another species of Phytophthora, probably Phytophthora terrestris [parasitica]. No spraying experiments were conducted to determine the effectiveness of spraying. The greatest amount of loss occurred in fields where the tomato plants were not staked, the fruit coming in close contact with the soil. The disease, however, was not confined to unstaked plants for some fields with staked plants were observed with heavy losses. (J. G. Leach)

TOMATO MOSAICS AND SPOTTED WILT (Virus)

MARYLAND: Virus diseases were not more prevalent than usual this year. The shoe-string type of Mosaic was abundant in home gardens, especially in the Baltimore area. A small amount of tobacco mosaic type virus

could be found in almost all tomato fields visited throughout the State. A virus disease not previously observed in this State was found in 3 tomato fields in western Maryland. Less than 1% of the plants were affected. The symptoms were identical with those of tip-blight. The plants in each of the 3 fields were traced to a particular shipment of plants from a southern State. The disease was not found in nearby fields set with plants from other shipments from the same State, nor was it observed in fields set with southern plants in other localities in Maryland. (C. E. Cox and Mark W. Woods)

NEW JERSEY: Mild mosaic is general throughout the State late in the season but does not appear to cause serious trouble if the crop is liberally fed. Yellow tobacco mosaic was of minor importance this year although in other years a field here and there may have 50 to 90% infected plants. The shoestring or fernleaf virus disease caused much more trouble than usual. It was very general in small garden plantings and caused very heavy losses in a few commercial fields. Little or no damage occurred in commercial plantings of large-fruited varieties but practically 100% infection was observed in one 5-acre planting of a plum tomato. Other fields of pear and plum types also showed abundance of the shoestring disease whereas adjacent plantings of large-fruited types (Marglobe and Rutgers) showed no infection. Until this year there was no economic reason to think of probable control measures but our experience in 1942 emphasized the potential importance of this disease. (C. M. Haenseler)

NEW YORK: The shoestring type of mosaic appeared in epidemic form in 1942. Hardly a garden planting escaped the virus, and some large fields showed as much as 35% of infected plants. One plant grower who sold more than 2 million plants unfortunately introduced the virus into his seed beds. He grew petunias in part of his range of greenhouses. The women employees apparently transmitted the virus from the petunia beds to the tomatoes. Petunias are one of the chief sources of inoculum. In New York State spotted wilt occurs on tomatoes only when they are inoculated in the seed bed by infected flower hosts growing near them. California Wonder pepper, however, becomes generally infected during certain seasons. The disease appears on them almost simultaneously throughout the entire State, usually some time in September. Apparently the erratic appearance of the disease is due to the prevailing temperatures. For instance, in March a group of greenhouses planted to tomatoes showed spotted wilt in such a serious condition that the entire crop seemed doomed. In early May the plants had almost fully recovered. During the cool weather the virus thrived, but as soon as the sun shone through the glass and the temperatures became abnormally high, the virus either died or became inactive. In the same way peppers must become infected in late summer, but show no symptoms until there is a week of cool weather, when the symptoms appear almost universally. (Charles Chupp)

PENNSYLVANIA: Mild or tobacco mosaic was general throughout the State. It was severe in some sources of home-grown plants, and in southern-grown plants. No severe outbreaks occurred. Shoestring or cucumber mosaic was very prevalent in home gardens in western Pennsylvania and some occurred in

the northeastern and central parts of the State. Spotted wilt occurred in one county in the western and one in the northeastern part. The average State loss was 1.5%. Control -- The mosaics in most cases were traceable to failure to eradicate other host plants in the seed bed area or to the use of tobacco by those handling plants. (R. S. Kirby, O. S. Cannon, and A. H. Bauer)

WEST VIRGINIA: Virus diseases were present although apparently not more abundant than in normal years. There was considerable loss in the vicinity of Morgantown caused by tipblight, a variety of spotted wilt. The source of infection in all cases was plants grown in one commercial greenhouse that was badly infected with the disease. The disease was not observed elsewhere in the State. (J. G. Leach)

TOMATO SEPTORIA LEAFSPOT (Septoria lycopersici)

DELAWARE: Septoria leafspot was in evidence as light infection early in the season but did not reach serious proportions until the latter part. Control by dusting or spraying was effective when applications were applied with sufficient frequency. Crowded plantings or those with poor air drainage showed less value from spraying or dusting than other plantings. (S. L. Hopperstead)

MARYLAND: Septoria leafspot is never as important as alternaria leafspot in this State. This year it was less prevalent than usual. Although it could be found rather generally in the latter part of the season the loss caused by this disease was probably negligible. (C. E. Cox)

NEW JERSEY: Very prevalent during late August and September and associated with Alternaria and Stemphylium, caused almost total defoliation in many fields by the time half the crop was harvested. Only few fields observed where Septoria was the sole blighting organism. Others showed Septoria and Alternaria, or Septoria, Alternaria, and Stemphylium on the same plants, giving a blight complex. Sprays gave only partial and inadequate control of this blight complex. (C. M. Haenseler)

NEW YORK: Where crop rotations and hot water seed treatment have been practiced, Septoria blight has been almost entirely eradicated. The only areas where it still is present are in counties where crop rotations are not practiced or in a very limited area where horse-nettle is prevalent. This weed apparently is the only outside source for inoculum. (Charles Chupp)

PENNSYLVANIA: Septoria leafspot was present throughout the State and was first observed May 27. The disease caused an average state loss of 10%. It was very destructive in the southeast, and above average in all other parts of the State. For the first time in many years Septoria was more destructive than Alternaria in southeastern Pennsylvania. Control -- Hot water seed treatment, seed bed spraying, and 3-year rotation checked the disease early in the season but excess rainfall allowed the pathogen to become destructive late in the season, in many sections of the State.

Wide spacing of plants in the field tends to check the disease. (R. S. Kirby, C. S. Cannon, C. D. Burke, A. H. Bauer, and G. L. Zundel)

WEST VIRGINIA: Septoria leafspot was more prevalent than usual in West Virginia. This can be explained partly by the heavy and frequent rainfall. In spite of conditions favorable to the development of Septoria leaf blight this disease was not as prevalent as Alternaria leafspot. In most cases the disease made its appearance late in the season and greatest damage was done in late summer. (J. G. Leach)

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SUPPLEMENT 141

COTTON SEEDLING DISEASES AND BOLL ROTS
DISTRIBUTION AND DISSEMINATION

April 1, 1943

COTTON SEEDLING DISEASES AND BOLL ROTS
DISTRIBUTION AND DISSEMINATION

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The following reports, by Paul R. Miller of the Division of Mycology and Disease Survey, and by Richard Weindling of the Division of Cotton and Other Fiber Crops and Diseases, summarize the results of 4 years of surveys for cotton diseases and of special studies on distribution and dissemination suggested by observations made during the surveys.

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A SUMMARY OF FOUR YEARS OF COTTON SEEDLING AND BOLL ROT DISEASE SURVEYS

Paul R. Miller

Prior to the initiation of these cotton disease surveys, seed treatment was known to be effective in controlling certain cotton seedling diseases; however, explanations for the results obtained were largely empirical since the organisms involved in the seedling-disease complex were definitely known only for a limited area. It appeared, therefore, that studies of a regional scope, over a period of several years, concerning the identity, distribution, and importance of the fungi associated with damping-off of cotton seedlings and with boll rots, should give a more effective basis for research on specific seed treatments for the different cotton-producing areas. [1]

Hence these surveys, in which samples were obtained in 14 States and from more than 2000 fields, were begun. They involved the cooperation of both Federal and State pathologists, to whom the author expresses his sincere appreciation.

Because of the present emergency it has been necessary to discontinue these surveys, therefore a brief summary of the results so far obtained, during the growing seasons of 1938 to 1941 inclusive, is presented herein. Detailed reports have been issued upon completion of each separate survey (1, 2, 3, 4, 5, 6, 7, 8). Methods employed, as well as a discussion of the first 2 years' findings, have also been presented (10). Portions of the following discussion have already appeared in the reports cited and in preparing this summary no especial attempt was made to avoid repetition.

Perhaps the most interesting finding made during these surveys concerns the wide distribution of Glomerella gossypii Edg. throughout the Southeastern States on both diseased seedlings and bolls. It occurred on 81.2% of the seedling samples and on 67.8% of the boll samples (Tables 1 and 2). However, in Texas and Oklahoma occurrence of this fungus was limited to the eastern portion of each State. Maps showing this distribution have been shown in various issues of the Plant Disease Reporter.

Failure to find the anthracnose fungus in the Western Belt is evidently attributable to unfavorable dry conditions which prevent its survival during the period between the damping-off stage and the boll-rot stage (Figure 1). Previous to our surveys it was assumed generally that anthracnose practically disappeared with the advent of the boll weevil, which had forced the adoption of early-maturing cotton varieties of open type. Perhaps failure to recognize that the epidemiology of boll rots has changed considerably since the pioneer work on anthracnose accounts for this erroneous assumption. In our collections symptoms on the majority of

1 This information now has an especial timeliness, also, in view of the anticipated shortage of certain chemicals used in the manufacture of seed treatment compounds.

Table 1. Fungi isolated from cotton seedling samples collected in 1938, 1939, 1940, and 1941

State	Number of samples examined	Number of samples found with: Glomerella gossypii	Fusarium moniliforme	Rhizoctonia solani	Fusarium spp.	Diplodia gossypina	Other fungi [a]
Alabama	151	137	138	15	60	4	57
Arkansas	129	119	121	34	49	3	66
Florida	20	19	16	3	20	4	24
Georgia	139	132	129	17	47	7	72
Kentucky	5	4	4	0	1	0	5
Louisiana	133	114	102	30	70	2	82
Mississippi	183	151	134	43	108	6	116
Missouri	5	5	5	0	2	0	1
North Carolina	67	49	43	4	35	3	54
Oklahoma	61	11	46	7	29	3	71
South Carolina	275	219	215	38	127	7	117
Tennessee	56	51	38	6	40	3	16
Texas	69	37	54	10	29	1	63
Virginia	59	50	50	3	31	2	33
Total	1352	1098	1095	210	648	45	777
Percentage		81.2	81	15.5	47.9	3.3	57.4

[a] Includes Alternaria spp.; Penicillium spp.; Aspergillus spp.; Pythium spp.; Sclerotium bataticola; and Sclerotium rolfsii.

Table 2. Fungi isolated from cotton boll samples collected in 1938, 1939, 1940 and 1941

State	Number of samples examined	Number of samples found with					
		Glomerella gossypii	Fusarium moniliforme	Alternaria spp.	Fusarium spp.	Diplodia gossypina	Other fungi [a]
Alabama	69	50	38	57	32	10	46
Arkansas	81	53	48	77	47	8	31
Georgia	83	71	62	77	48	29	60
Kentucky	4	4	1	4	4	0	0
Louisiana	44	34	25	24	31	11	30
Mississippi	223	193	180	168	193	35	117
Missouri	8	2	5	8	5	0	2
New Mexico	2	0	0	2	0	0	1
North Carolina	66	53	40	62	19	4	39
Oklahoma	77	5	35	76	41	4	31
South Carolina	211	169	147	198	113	26	127
Tennessee	19	7	6	19	12	1	10
Texas	98	19	50	93	58	1	27
Virginia	44	38	27	35	18	6	29
Total	1029	698	664	900	621	135	550
Percentage		67.8	64.5	87.5	60.3	13.1	53.4

[a] Aspergillus spp., Rhizopus spp., and Penicillium spp.

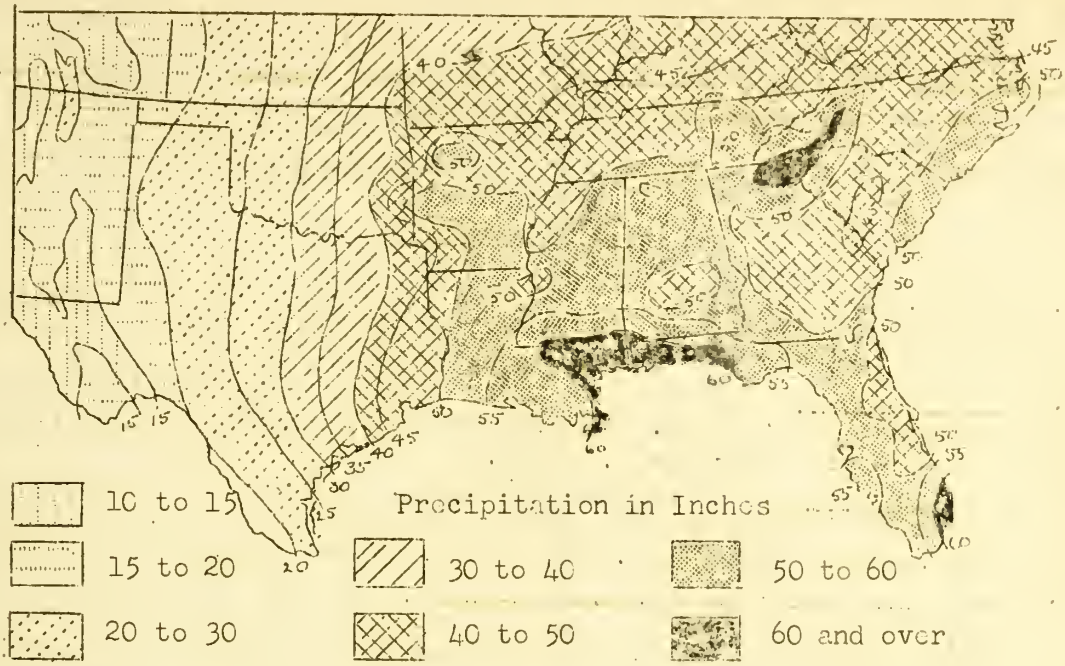

Fig. 1. Annual rainfall in the cotton belt of the United States

specimens from which the anthracnose fungus was cultured did not conform to those described earlier, in that the lesions were usually much smaller, they were not sunken and brownish in color with a red border, and only rarely were the moist, pinkish, pasty looking masses of spores encountered. Most boll lesions from which G. gossypii was isolated were limited spots, usually water-soaked in appearance, and indistinguishable from those caused by the angular leafspot bacteria (Xanthomonas malvacearum), or by other microorganisms. Field observations and other evidence obtained during these surveys indicated that X. malvacearum plays an important role with respect to the anthracnose boll disease by providing infection courts for G. gossypii (9). Apparently boll weevil punctures are also courts of entry, particularly during the latter part of the season.

Fusarium moniliforme Sheld. and other species of Fusarium occurred on both seedlings and bolls about as frequently as did G. gossypii. However, it is difficult to evaluate the significance of the high percentage of F. moniliforme since this fungus does not appear to be a primary pathogen of damping-off of cotton seedlings. This is true also for the various other species of Fusarium isolated, since little is known regarding their pathogenicity to cotton seedlings. On bolls these Fusaria, as well as Alternaria spp., are considered mainly as secondary invaders, entering the bolls through lesions caused by other agents.

Rhizoctonia solani Kühn, which is a virulent seedling pathogen, although isolated from a relatively small number of samples (15.5%), was found to be rather widely distributed.

The occurrence of the following fungi, whose pathogenic effects are not so well known, was sufficiently common to deserve mention: Diplodia spp.,

Penicillium spp., Aspergillus spp., Sclerotium rolfsii Sacc., Pythium spp., Sclerotium bataticola Taub., Rhizopus spp., and Chaetomium spp.

During the surveys under discussion certain observations led to work reported in the next 4 articles of this Supplement.

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(DIVISION OF MYCOLOGY AND DISEASE SURVEY. CHAIRMAN, COTTON DISEASE SURVEY COMMITTEE).

OCCURRENCE OF THE ANTHRACNOSE FUNGUS, GLOMERELLA GOSSYPII, ON COTTON PLANTS GROWN FROM INFESTED SEED AT FOUR LOCATIONS IN 1941

Richard Weindling

This report deals with the epidemiology of the anthracnose disease of cotton between seedling and boll phase. Two pertinent problems have been brought into bold relief by the seedling and boll disease surveys: 1) How does the anthracnose fungus survive and spread during the summer months? and 2) Is its scarcity in western Texas and Oklahoma due to the prevailing summer climate?

With respect to the second question, the available evidence is mostly circumstantial. Present conditions have brought about abandonment of plans along those lines of the work which were expected to furnish adequate data.

The first question has been answered to some extent by Atkinson (2) as early as 1892. He found the fungus fruiting on dead portions of leaves and stems, particularly around leaf scars. Later investigators confirmed this observation. More recently, culture work has supplemented these data. In 1938, a high percentage of plants used in experiments on *Fusarium* wilt at Clemson, South Carolina, yielded cultures of the anthracnose fungus. It was obtained from basal portions of surface-disinfected stems. Subsequently, the fungus was cultured from apparently healthy tissues of seedlings that had been inoculated with *G. gossypii* (4), and from stems, petioles, and leaf glands of mature field-grown plants (1). Such "latent" infection is known in anthracnoses of some other plants. In such infected tissues, the fungus is ready for sporulation whenever some of the tissue breaks down and moisture conditions are favorable.

The procedure chosen to investigate the aforementioned problems was the following: 1) To gain a well-rounded picture of occurrence and spread of the anthracnose fungus, portions of cotton plants grown from infested seed were cultured and examined at frequent intervals during the growing season; 2) To study the effect of climatic conditions, comparable material was secured from several locations.

Materials and Methods

Seed of the variety Miller, heavily infested with the anthracnose fungus, was planted at the following Experiment Stations: Florence, South Carolina (coastal plain); Clemson, South Carolina (Piedmont); Knoxville, Tennessee; and Temple, Texas (black land)[1].

Whole plants or portions of plants chosen at random were collected at intervals during the season. Samples from Florence and Clemson were brought directly to the laboratory. Except for the last shipment, samples from Texas were forwarded by air mail.

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[1] The writer gratefully acknowledges the cooperation of Paul R. Miller, Knoxville, and C. H. Rogers, Temple, who planted the seed and collected the material from these two locations.

On arrival in the laboratory the specimens were treated as follows: Pieces were cut from seedlings, stems, and bolls. They were surface-disinfected, cultured, and examined as described elsewhere (4). The material taken from the stems of plants after the thinning stage consisted of uninjured bark portions including a part of a leaf scar when possible. These sections were cut at 2 or 3 levels of the stem, the lowest at the soil surface or at the cotyledonary node, and the highest at the second woody node. Leaves were wrapped separately in moist paper towels and incubated for 2 days in moist chambers at 24°C. Washings from the leaves were mounted on glass slides and observed for fungous spores. Leaf petioles, corollas, and bracts were similarly treated, the latter without previous incubation.

Data were taken on 25 or 50 specimens, when available. With respect to numbers of specimens as well as of samples, those from Clemson and Temple were inadequate. Stands of these 2 plantings were poor, and development of the plants was not uniform. At Clemson dry weather delayed germination, while at Temple, moisture conditions made replanting necessary. Excepting the first sample, material from Temple came from both original and replant plantings.

Results

A summary of results is presented in Table 3 in which occurrence of Glomerella gossypii is listed as percentages of specimens examined. The most obvious feature of this summary is the frequency of positive observations in the samples from Knoxville and Florence as contrasted to those from Clemson and Temple. It appears that, even when adequate samples were secured from the latter 2 locations and the anthracnose fungus was found, it was not present in a high percentage of specimens, except at the seedling stage. The most interesting single result is the appearance of the fungus in the last sample from Texas.

From the data presented here, it is difficult to draw conclusions regarding the relative frequency of the fungus on the various plant organs. Previous work had demonstrated that development and detection of spores on leaves is greatly facilitated by incubating dead or injured portions in moist chambers. When the bracts were placed in a moist chamber, the percentage of G. gossypii was raised above that for leaves of the same sample. In general, cultures from the middle portion of the stem yielded the fungus more frequently than those from the basal part. Competing soil organisms may play a role with respect to isolation and survival in the basal part. Isolations from petioles were secured, but not regularly. In one case (last Temple sample), the percentage of Glomerella-infected petioles was higher than that of the leaves. Spores of the fungus have been found frequently in the dead tissues of nectar glands of leaves and petioles. Perhaps these glands deserve the special emphasis placed upon them by some observers of summer survival (1).

Summaries of weather data from the 4 locations are presented in Tables 4 and 5 for consideration in conjunction with the results summarized in Table 3. It is apparent at first glance that simple and general correlations can not be derived from these 3 tables.

Table 3. Percentage occurrence of Glomerella gossypii on cotton plants grown from infested seed (var. Miller) in 4 locations in 1941

Location and Date of collection	Tissue cultures from portions of stem			Leaves	Corollas	Bracts	Bolls	
	Upper	Middle	Lower				Cul-tur-ing	Scrap-ing
Clemson, S.C. (planted May 3)								
June 2	-	-	60.0	-	-	-	-	-
June 26	0	0	4.0[a]	40.0[b]	-	-	-	-
July 24	0	0[a]	0	28.6	-	-	-	-
August 7	-	-	-	50.0[b]	20.0	-	-	-
August 21	0	0[a]	0	8.6	0	0	0	-
September 5	-	-	-	-	-	30.0[b]	24.0	-
October 16	8.0	0[a]	0[a]	18.0[a]	-	8.0	-	8.0
Florence, S.C. (planted April 15)								
April 29	-	-	26.7[b]	-	-	-	-	-
May 15	-	-	25.6	-	-	-	-	-
June 12	0	0	16.0	-	-	-	-	-
July 2	4.0	2.0	0.0[a]	10.0[b]	0[b]	-	-	-
July 19	16.0	16.0	-	85.0	52.0	-	15.0	-
August 13	52.0	80.0[a]	20.0	85.0[a]	-	60.0	60.0	-
August 28	88.0	96.0	28.0	95.0	-	100.0	86.6	-
Knoxville, Tenn. (planted April 30)								
May 25	-	-	72.0	-	-	-	-	-
June 20	-	-	36.0	-	--	-	-	-
July 7	8.0	40.0	18.0[a]	60.0[b]	-	-	-	-
July 26	-	8.0	18.0	32.0	0[b]	-	0[b]	-
August 11	-	12.0	24.0	56.0	-	20.0	10.0	-
August 30	-	64.0	32.0	100.0	-	100.0	40.0	-
September 14	-	-	-	60.0	-	30.0	25.0	-
October 9	32.0	34.0[a]	12.0[a]	68.0[a]	-	29.5[a]	-	10.0[a]
Temple, Texas (planted about April 25 and May 25)								
May 12	-	-	45.7	-	-	-	-	-
July 5	0	0[a]	0	-	-	-	-	-
July 28	-	0[b]	-	0	0	-	-	-
September 9 & 15	0[b]	-	-	0[b]	-	0[b]	0[b]	-
September 25	0	8	2[a]	24.0[a]	-	5.0[a]	-	8.0[a]

Note: Percentages based on observations of 25 specimens, except as indicated in footnotes:

[a] Percentages based on 50 observations.

[b] Percentages based on 10-15 observations.

Table 4. Monthly rainfall and days with rainfall at the 4 locations

Month	Clemson		Florence		Knoxville		Temple	
	Rainfall in inches	Days with .1 in. or more	Rainfall in inches	Days with .1 in. or more	Rainfall in inches	Days with .1 in. or more	Rainfall in inches	Days with .1 in. or more
April	1.61	3 4 9 23 24	3.02	1 5 6 11 25	3.95	4 5 21 24 25	6.21	3 7 19 21-28
May	.72	7	.67	8	0.52	8 31	4.15	3 5 11 19 21
June	2.69	2 3 7 10 11 22 23	8.75	3 4 11-13 15 21 23-29	2.49	10-15	6.25	3 6 7 10 16 26 27
July	6.56	3-7 14-16 19	6.33	5-7 11 13 15-19 23	7.24	3-7 9 10 15 17 20	3.80	4 11 12 14
August	5.90	1 3-5 19-21 27	5.83	4 17 21 23 24	3.14	5 13 16 26-28	2.70	4 6 7
Sept.	.63	24-26	1.62	5 6 26 27	0.42	5 10 13	0.44	16 23
Total	18.11		26.22		17.76		23.55	

Table 5. Monthly average mean temperatures at the 4 locations

Month	Mean temperature (°F.)			
	Clemson	Florence	Knoxville	Temple
April	63.11	65.2	62.8	66.8
May	71.5	71.7	68.9	74.8
June	76.7	77.2	74.8	79.1
July	79.0	80.5	79.4	82.5
August	79.7	79.3	79.2	83.6
September	75.1	77.0	75.8	80.9

The trends of the Florence data are rather easily explained. Rapid emergence kept seedling infection low. In July, the fungus began to spread rapidly. Owing to frequent rains, corollas adhered to the tips of bolls for weeks forming an incubation chamber for Glomerella (found on 52% of the corollas of one sample) and other fungi. Many early bolls rotted from the tip down, a condition causing severe damage in the Coastal Plain Section. Heavy aphid infestation in August covered all aerial plant organs with honey-dew which provided an ideal medium for the growth of the anthracnose fungus. This, together with progress of the weevil on bolls, may account for the progressive increase in frequency up to the last sampling.

A similar "building-up" trend is noticeable in the Knoxville data from late July through August. The fungus was found, however, from the seedling stage until July on a fairly high frequency level. The decrease in the fall may be connected with lack of rainfall, absence of boll weevil, and with a leaf worm infestation which practically defoliated the plants.

At Clemson, climatic conditions throughout the season were very similar to those at Knoxville. Nevertheless, frequency percentages of the fungus were generally lower. A possible explanation of this divergence is that the irregular growth and stand of the plants did not provide sufficient shade to prevent the plant parts from drying very rapidly.

In the first Temple planting, anthracnose injury to seedlings was high. Summer survival of the fungus is considered uncommon in this section of Texas. The somewhat unusual development on seedlings was attributed to an abnormally rainy spring. The data from the limited number of samples submitted give some indication that over-summering was more difficult than in the eastern locations. This is probably attributable to the small number of rainy days in July and August at Temple.

Discussion

Students of the anthracnose diseases of bean and cucumber have demonstrated that the causative fungi are able to remain dormant and thus survive for long periods as mycelium in tissues or as appressoria attached to the surface. With respect to the dissemination of these fungi, rain is considered the principal agency. The spores are spread by run-off water over the soil surface where they have been found to retain their viability for

several days. Rain drops splash spores from leaf to leaf, from plant to plant, and from the soil on to the plants. The fungi become most easily established in tissues affected by some kind of injury. Infection is favored by moderate temperature and high moisture, the same conditions that benefit subsequent sporulation.

This evidence, though obtained principally for other anthracnoses, is applicable as a general background for the data presented here. The cotton anthracnose fungus has survived in 1941 at all 4 locations. It remained well distributed and active throughout the season at Knoxville, fluctuated at a lower level of frequency at Clemson, remained quiescent during most of the season at Temple, and built up rapidly after an initial latent period at Florence. The fungus seemed to be capable of rapid spread whenever conditions became favorable, and, if they remained so over a considerable period, it built up to epidemic proportions (Florence). Periods of rainfall and rather cool, cloudy weather are no doubt primary factors for dissemination. Of equal importance, however, seem to be factors connected with the saprophytic habit of the fungus. Chief among these appears to be the availability of injured, dying, or dead plant tissues which usually become more abundant as the organs of the plant mature. Lesions caused by other disease organisms or insects may play a significant role. Furthermore, close stands and large plants tend to provide more shade than open stands and small plants, and therefore more decomposing material and a more favorable micro-climate for the fungus (Knoxville and Florence vs. Clemson and Temple).

It is noteworthy that pink spore masses, commonly considered as a sign of the anthracnose disease, were not observed on any of the stem or leaf portions which on culturing or incubation yielded the anthracnose fungus. Similarly, seasoned observers agreed that the severe rot of early bolls occurring in 1941 in eastern South Carolina was not pink boll rot or anthracnose. However, in fields of this section planted with Ceresan-treated seed, the anthracnose fungus was found on rotted bolls as well as on other plant organs nearly as often as in the collections from Florence analyzed in this study. Evidently, the fungus frequently occurs in association with other organisms that tend to obscure outward signs of its presence. The importance of these potential or hidden sources of inoculum will be emphasized further by portions of the following article dealing with the role of trash in seed infestation during ginning.

Summary

Evidence has been obtained on the presence and spread of the anthracnose fungus during the 1941 season, and on the influence of climatic factors, by examining and culturing, at intervals, portions of cotton plants grown from infested seed at 4 locations. The fungus was found at all locations in the seedling and boll stage, and at the 3 eastern locations throughout the summer on stems, leaves, and bracts. Simple relationships between climatic factors and relative abundance of the fungus could not be established. The data indicate that, in addition to periods of rainfall, other factors are important, such as the availability of dead plant tissues and of shade provided by close stands of large plants. It is suggested that

the fungus over-summered at Temple, Texas, in a quiescent form, and that unusually wet spring weather gave a better chance for its persistence than in ordinary years.

In the eastern parts of the cotton belt, the anthracnose fungus frequently infects stems, leaves, and other organs of the cotton plant. When moisture conditions become favorable, such latent infections are followed by saprophytic development in rotting tissues that provide potential sources of inoculum for boll infection and seed infestation.

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RELATION OF GINNING TO CONTAMINATION OF COTTON SEED BY THE ANTHRACNOSE FUNGUS

Richard Weindling and Paul R. Miller

During the cotton disease surveys, the observation was made that the number of bolls infected with the anthracnose fungus, *Glomerella gossypii*, was very small when considered in relation to the frequency of the fungus as a seedling parasite. Often, most of the seedlings in large fields had anthracnose lesions, but it was rare during any of the 4 yearly boll surveys to find a field with as many as 1% of the bolls infected. The assumption that the seed is the principal source of seedling inoculation is supported by the effective results of seed treatment. It seems improbable, however, that infected seedlings originate only from the seed derived from so few diseased bolls.

The theory was advanced that seed may become contaminated with the anthracnose fungus during ginning. Exploratory examination of materials collected from gins near Clemson, South Carolina, made it manifest that "trash"[1] carries even more conidia of *G. gossypii* than seed. In modern gins most of this trash is removed from fiber and seed by extracting and cleaning equipment. These operations are accompanied, however, by vigorous whirling and mixing of the seed cotton. It should be expected that spores and small particles carrying the fungus are effectively distributed during ginning, just as agitation spreads germicides in seed treatment operations. Seed free from *G. gossypii* may thus become contaminated by

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[1] The term trash is used here to designate broken bolls, hulls, pieces of leaves, stems, bracts, petioles, and other debris that has been picked with the seed cotton.

spores originating not only from other seed and from bolls but also from infected plant organs contained in the trash. Furthermore, particles of trash may adhere to machinery of the gin, attach themselves to seed of lots ginned subsequently, and thus contaminate them.

The data presented here are concerned principally with (1) findings of conidia of Glomerella on samples of seed and trash collected from gins in South Carolina during the past 3 seasons, and with (2) supplementary work on seed contamination produced by adding contaminated trash to seed cotton prior to ginning. The spore load determinations are quantitative, and reveal some effects of sectional, seasonal, and climatic factors on seed contamination. Such data may be useful as a background for further investigations along this line.

Materials and Methods

Samples of seed and trash were brought to the laboratory in paper bags and stored until used. Glomerella contamination was determined by 2 methods: (1) germinating 2 aliquots of 100 seed in flats with steamed sand in the greenhouse, and (2) counting spores washed from the seed or trash as described below. These two methods were also used with seed resulting from the experimental ginning.

In 1939, all samples were taken at one gin in the upper Piedmont, 2 samples of seed and trash being derived from a given lot of seed cotton. In 1940 and 1941, samples were collected from numerous gins throughout South Carolina, one sample of seed and trash per gin[2]. Conditions at most gins made it impracticable to secure seed and trash from the same lot of seed cotton.

The procedure for counting conidia of Glomerella gossypii was essentially as follows. One hundred grams of seed or 40 grams of trash were shaken vigorously with 300 cc. of water in quart jars. The washings were passed through cheese cloth. Washings from seed were centrifuged to 1/100 the original volume. Spore counts were made of these concentrates and of the trash washings with a haemocytometer commonly used in counting spores or blood cells. Determinations from 2 drops were usually found sufficient. If they varied considerably or if Glomerella spores were absent, results from additional mounts were averaged to obtain an estimate of spore load. This method has been employed from 1939 to 1941 by the senior writer with minor modifications. The junior writer has contributed to this study the 1941 data on spore load of seed. He has used an improved version of the above method as described by him in detail in a previous report, (P.D.R. 24: 85. 1940).

Results of Collections from Commercial Gins in 1939, 1940, and 1941

The principal features of the data assembled in tables 6-8 and of concurrent observations may be expressed as follows:

(1) All washings of trash samples (except one) yielded conidia of G. gossypii. Samples with a preponderance of fine trash (broken leaves,

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[2] Thanks are due to Mr. C. C. Bennett for collecting many of these samples.

Table 6. Glomerella contamination of samples collected from a gin in the Upper Piedmont of South Carolina in 1939

Seed Cotton lot no.	Sample no.	Seedling disease index [a]	Spores of G. gossypii	
			Per seed	Per mg. trash
1	1	85	268	463
	2	58	296	314
2	1	81	19	420
	2	84	19	108
3	1	49	16	177
	2	55	28	36
4	1	59	0	223
	2	65	0	156
5	1	61	0	59
	2	58	6	183
6	1	81	0	52
	2	84	0	17
7	1	69	88	297
	2	70	32	389
8	1	52	32	296
	2	59	19	223
9	1	79	161	320
	2	32	153	228
10	1	73	120	297
	2	69	19	263

[a] Index obtained by subtracting from 100 the percentage of healthy and 1/2 the percentage of lesioned plants.

bracts, and other debris) had spore loads varying in the same range of magnitude as those of coarse trash (hulls, broken bolls, pieces of stems). This might have been expected from the findings of G. gossypii on leaves and other organs of field plants discussed in the preceding article.

(2) In all seed samples without exception, presence of the anthracnose fungus was demonstrated by microscopic examination of lesioned seedlings obtained in the germination test. Glomerella gossypii caused most of the pre- and post-emergence losses combined in the tables as a disease index.

(3) Spore loads of the anthracnose fungus on seed samples varied more widely than disease indices. Spores were not detected by the washing-centrifuging method in several samples that had considerable Glomerella damping-off when germinated.

(4) Spore loads on seed as well as on trash were generally higher in 1941 than in 1940. The spore loads in samples from the Coastal Plains section exceeded those from the Piedmont in 1941, but not in 1940. Evidence given in the preceding article suggests that rainfall in June, July, and August is a decisive factor with respect to spread of Glomerella in the field. In 1940, June and July rainfall in South Carolina was below normal.

Table 7. Glomerella contamination of samples collected from South Carolina gins in 1940. Nos. 1-14 are from the Piedmont, Nos. 15-24 from the Coastal Plain Section

Sample no.	Seedling Disease Index [a]	Spores of G. gossypii Per seed	Spores of G. gossypii Per mg. trash
1	42.0	0	85
2	45.3	0	120
3	85.8	117	780
4	53.5	12	128
5	53.6	16	280
6	49.3	0	64
7	49.4	59	48
8	48.2	18	32
9	67.3	0	60
10	73.9	24	11
11	84.4	39	20
12	80.7	169	496
13	84.4	813	416
14	63.2	29	144
15	85.7	157	70
16	46.7	40	47
17	74.0	146	520
18	57.9	8	0
19	74.3	513	688
20	74.3	15	40
21	66.7	19	190
22	43.0	42	200
23	85.3	78	325
24	76.7	32	540

[a] See footnote Table 6

In 1941, it was considerably above normal, particularly in the Coastal Plain. August rains were about normal in 1941, and much above normal in 1940, but in the latter case they fell in a few days of heavy storms.

(5) The viability of many seed of the Coastal Plain samples of 1941 was low, as indicated by germination of delinted seed (Table 8). Internal infection was present in some seed of all these samples, but only in few samples from the Piedmont. Correlations were not noticeable among the data on viability, internal infection, disease index, and spore load. The absence of correlations may be due to the heterogeneity of the samples. Some duplicate samples from the same gin even showed considerable variation (Table 6).

Table 8. Glomerella contamination of samples collected from South Carolina gins in 1941. Nos. 1-22 are from the Coastal Plain, Nos. 23-43 from the Piedmont

Sample no.	Percent non-viable seed	Disease index [a]	Spores of G. gossypii: Per seed	Spores of G. gossypii: Per mg. trash
1	40	72.3	80,000	3,575
2	49	74.5	4,000	3,028
3	43	89.5	1,000	6,133
4	26	80.0	32,000	4,916
5	38	77.8	48,000	3,268
6	40	76.0	64,000	7,110
7	52	85.0	2,000	11,523
8	49	74.8	0	1,875
9	37	85.8	0	6,660
10	35	81.3	16,000	1,738
11	18	54.5	0	4,745
12	16	54.5	2,000	5,430
13	36	80.0	48,000	6,543
14	35	83.8	16,000	3,413
15	10	82.8	4,000	6,483
16	18	78.0	4,000	3,145
17	17	64.8	16,000	2,833
18	31	86.5	32,000	4,590
19	23	76.3	2,000	1,348
20	51	94.3	trashy	3,425
21	24	84.0	80,000	4,443
22	14	73.3	160	2,785
23	9	56.0	3,000	980
24	4	94.0	1,000	508
25	6	97.0	60,000	548
26	7	53.5	160	13
27	7	85.3	3,000	3,035
28	5	68.3	1,000	2,690
29	5	82.3	3,000	2,175
30	9	67.8	0	155
31	11	60.3	0	100
32	8	80.8	120	118
33	2	81.5	4,000	93
34	6	47.5	200	52
35	14	62.0	3,000	483
36	11	49.0	2,000	483
37	16	48.0	160	885
38	8	65.5	0	938
39	9	34.0	0	13
40	8	22.5	80	313
41	78	84.8	0	430
42	6	51.5	48,000	1,095
43	6	64.3	16,000	1,600

[a] See footnote Table 6.

Table 9. Averages of data from 1940 collections

Section	Number of samples	Seedling disease index [a]	Spores of G. gossypii	
			Per seed	Per mg. trash
Piedmont	14	62.9	91	192
Coastal Plain	10	68.5	105	262
Piedmont and Coastal Plain	24	65.2	98	221

Table 10. Averages of data from 1941 collections

Section	Number of samples	Percent germination of delinted seed	Seedling disease index [a]	Spores of G. gossypii	
				Per seed	Per mg. trash
Piedmont	21	88.8	64.6	6,891	796
Coastal Plain	22	68.1	77.7	21,484	4,500
Piedmont and Coastal Plain	43	78.2	71.3	13,858	2,691

Table 11. Effect of trash on seed contamination with G. gossypii. One-half pound of trash was added to each 5 lb. lot of seed cotton, except to control lots, prior to ginning. Lots ginned in order of numbers

Lot Number	Trash added		Disease index [a]	Spores of G. gossypii per seed
	Kind	Spore Load		
1	control	---	21.5	--- [b]
2	fine	low	22.0	--- [b]
3	fine	medium	39.5	23
4	fine	high	82.3	410
5	control	---	36.0	--- [b]
6	coarse	high	84.0	1,000
7	control	---	37.5	--- [b]
8	coarse	very high	80.5	88,000
9	control	---	88.3	138

[a] See footnote Table 6.
[b] Spores found; number below 12 per seed.

Results of Ginning Experiments

The findings on trash with regard to frequency and abundance of conidia of G. gossypii led to attempts at inducing seed contamination during ginning by the addition of trash. A preliminary test in 1939 gave positive results. An experiment was conducted in 1940 in order to gain information regarding (1) extent of contamination of trash in relation to that of seed, and (2) carry-over of Glomerella from contaminated to non-contaminated lots. The seed cotton was divided into aliquot lots. They were ginned in the order given in Table 11, after some of them had been amended with weighed amounts of trash. These trash samples were secured during the surveys and their degree of contamination was as indicated in Table 11. With increase in the spore load of the trash contamination also increased. Highly contaminated trash brought about very severe seed contamination as well as carry-over to the lot ginned subsequently. In the samples ginned after the lots that had become less heavily contaminated, some carry-over was evident in seedling infection but not in spore load. Without doubt, carry-over would have been larger in commercial gins where seed and trash are not removed from the gin after each sample as was done in the experiments.

The gin used in this experiment was a small hand gin that had only the essential parts of modern gins, gin saws and roll box or gin breast. A comparable experiment on a gin equipped with feeding and cleaning machinery of modern gins was made possible in 1941 at Knoxville, Tennessee. A lot of 50 lb. of seed cotton was ginned while adding 4 lb. of heavily infested trash. The resulting seed became contaminated with the anthracnose fungus at the rate of 2318 spores per seed (average of 22 determinations). Seed from the original seed cotton was slightly contaminated but the spore-load determination was negative.

Discussion

Seed contamination with Glomerella has been indicated here by 2 data, disease index and spore load. It is realized that neither of these is completely satisfactory when it is desired to compare heterogeneous seed lots. The disease index gives an indication of the maximum damage that might occur with seed planted in the field. Spore-load data constitute a more quantitative measure of contamination, but the washing-centrifuging method does not reach low spore loads. Glomerella damping-off has been produced by inoculation of seed with low spore loads. Experiments of the senior writer along this line will be reported elsewhere. Working with naturally contaminated seed, however, other factors may have to be taken into consideration, such as appressoria and dormant mycelia of Glomerella which would not be removed by washing seed, and other seed-borne organisms involved in seedling diseases.

The present study points toward a consideration of some practical importance. If seed cotton is not picked clean of trash in the eastern part of the cotton belt, the seed is likely to become contaminated with the anthracnose fungus, even though ginning removes most of the trash. This is particularly true when the trash is heavily infected. In the

ginning experiments, trash carrying a low spore load did not cause serious contamination of seed, although the amounts of trash added were about 6 times larger than those normally present in seed cotton. In 1941, average spore loads on seed and on trash were much higher than in 1940 (tables 9 and 10).

Carry-over of G. gossypii in the gin from one lot of seed cotton to the other has been investigated. This material is presented in the accompanying article, "The Dissemination of Fungus Spores from Contaminated Seed Cotton During Ginning in Relation to the Germination of the Seed and the Diseases of the Seedlings".

Summary

Samples of cotton seed and of trash were collected from gins in South Carolina during 3 successive seasons. Nearly all samples were found to be contaminated with the anthracnose fungus, Glomerella gossypii. Spore-load determinations revealed some effects of seasonal, sectional, and climatic factors on seed contamination.

Experiments have been conducted on contamination of seed by G. gossypii during ginning. Addition of infected trash to seed cotton prior to ginning produced contamination of seed. The degree of seed contamination depended on that of the trash. Carry-over of the fungus was obtained in lots ginned subsequent to heavily contaminated seed cotton.

It is concluded that contamination of seed in the gin accounts for much of the Glomerella damping-off of seedlings extant in the eastern part of the cotton belt, and that infected trash plays an important role in this contamination process.

THE DISSEMINATION OF FUNGUS SPORES FROM CONTAMINATED SEED COTTON DURING GINNING IN RELATION TO THE GERMINATION OF THE SEED AND THE DISEASES OF THE SEEDLINGS

Paul R. Miller

The purpose of the work herein reported was to determine the amount of Glomerella fungus contamination that results from ginning Glomerella-free cotton following contaminated cotton, and at the same time to secure information on spore loads of the common fungi occurring on the seed as related to germination of the seed and diseases of the seedlings.

For this seed spore load survey, varieties of cotton, grown in 4 locations, 2 of which -- Florence, South Carolina and Tifton, Georgia -- were known to be in anthracnose areas, and 2 of which -- Tipton, Oklahoma and Lubbock, Texas -- were in western areas where the disease usually does not occur, were sent to Stoneville, Mississippi and ginned in the order of listing in Table 12. Before ginning, seed cotton samples of these 41 varieties were bagged and transmitted to us along with the ginned samples. Spore load determinations of Glomerella gossypii, Fusarium spp., Diplodia spp., and Alternaria spp. were made utilizing methods previously described (P.D.R. 24: 85-92, 1940).

Table 12. Number of spores per seed compared with the percentage germination of the seed and the amount of disease on the seedlings

Sample no.	Number of spores								Percent germination	Disease index
	Glomerella gossypii		Fusarium spp.		Diplodia spp.		Alternaria spp.			
	a	b	a	b	a	b	a	b		
Florence, South Carolina										
1	15,000	20,000	300	1,800	0	200	200	600	69	50.5
2	10,000	20,000	600	10,000	0	0	0	1,800	72	59.5
3	5,000	10,000	1,400	10,000	0	400	0	1,200	58	46.5
4	5,000	5,000	1,800	5,000	0	0	0	400	77	51.5
5	10,000	5,000	1,000	10,000	0	0	0	1,000	79	51.5
6	25,000	35,000	600	10,000	0	0	0	800	87	73.2
7	25,000	12,000	1,000	10,000	0	400	0	1,200	75	66.5
8	25,000	15,000	5,000	8,000	0	0	0	800	74	58.0
Average	15,000 ~~8,125~~	15,250	1,462	8,100	0	125	25	975	74	57.2
Tipton, Oklahoma										
9	800	0	200	5,000	0	0	0	5,200	69	5.2
10	200	0	1,200	800	0	0	0	1,600	84	9.5
11	0	0	600	5,000	0	0	200	3,400	81	2.7
12	200	0	1,200	800	0	0	200	6,000	89	7.5
13	0	0	5,000	20,000	0	0	200	4,400	79	5.5
14	0	0	10,000	15,000	0	0	400	6,800	78	1.5
15	0	0	5,000	20,000	0	0	200	4,000	84	4.0
16	0	0	1,200	25,000	0	0	400	2,400	93	11.0
17	0	0	600	10,000	0	0	0	2,600	88	2.2
18	0	0	800	15,000	0	0	400	2,600	76	23.2
19	0	0	25,000	160,000	0	0	0	6,800	70	4.2
20	0	0	5,000	10,000	0	0	200	3,200	94	4.2
21	0	0	15,000	25,000	0	0	0	2,200	84	2.7
22	0	0	5,000	20,000	0	0	0	2,800	84	1.7
23	0	0	600	15,000	0	0	0	4,400	88	1.2
24	0	0	800	5,000	0	0	400	2,600	74	2.5
Average	75	0	4,825	21,975	0	0	163	3,813	82	5.6

[a] Seed from ginned cotton.
[b] Seed from unginned cotton (seed cotton).

Table 12. Number of spores per seed compared with the percentage germination of the seed and the amount of disease on the seedlings (continued)

Sample no.	Number of spores: Glomerella gossypii		Fusarium spp.		Diplodia spp.		Alternaria spp.		Percent germination	Disease index
	a	b	a	b	a	b	a	b		
Tifton, Georgia										
25	10,000	20,000	5,000	15,000	0	0	0	3,800	69	58.0
26	5,000	10,000	1,400	25,000	0	200	400	400	79	58.5
27	800	5,000	600	30,000	0	0	0	1,000	80	57.5
28	800	15,000	1,000	35,000	0	200	0	600	77	59.0
29	5,000	5,000	800	20,000	0	0	0	800	79	59.7
30	15,000	5,000	600	10,000	0	0	200	800	85	59.7
31	800	600	5,000	15,000	0	200	0	2,000	80	57.2
32	400	400	5,000	20,000	0	0	0	1,200	92	53.2
33	400,000	80,000	600	15,000	0	800	0	1,200	70	68.7
34	5,000	800	800	5,000	0	200	0	800	86	55.2
Average	44,280	14,180	2,080	19,000	0	160	60	1,260	80	58.7
Lubbock, Texas										
35	400	0	800	1,000	0	0	0	1,600	77	8.5
36	200	0	200	1,000	0	0	200	600	81	13.5
37	0	0	0	600	0	0	0	200	86	10.7
38	0	0	0	25,000	0	0	0	1,200	82	7.5
39	0	0	15,000	20,000	0	0	0	1,800	74	6.2
40	0	0	1,000	5,000	0	0	200	1,800	72	3.7
41	0	0	0	200	0	0	0	600	65	3.2
Average	86	0	2,425	7,542	0	0	57	1,114	77	7.6

[a] Seed from ginned cotton.
[b] Seed from unginned cotton (seed cotton).

The germination percentage determinations of the various seed lots were made by D. M. Simpson. He used the standard laboratory germinating technique approved by the Association of Official Seed Analysts.

The disease indices were determined by Richard Weindling. Two replicates of 100 seedlings each for each ginned sample were grown in sterilized sand, and the disease index was derived by adding the number of dead plants to 1/2 the number of lesioned plants.

The results presented in Table 12 show that Glomerella gossypii occurred on the seed of all samples of both unginned and ginned cotton from Florence, South Carolina and Tifton, Georgia, but it was obtained from none of the

samples of the unginned cotton from Tipton, Oklahoma and Lubbock, Texas, and from only the first 4 of the ginned samples from Tipton and the first 2 from Lubbock. This shows that after ginning the infested cotton, spores left on the ginning equipment caused sufficient contamination of the originally disease-free seed to be detected by the spore-load determination method. It should be pointed out here that the anthracnose fungus occurred on a limited number of seedlings resulting from the seed of all ginned samples from Texas and Oklahoma, even though the mechanical method had revealed its occurrence on only 5 of the 23 samples. This inconsistency is attributed to the shortcomings of the technique and insufficient knowledge of the disease. However, the dependability of the method for determining spore loads in excess of 200 spores per seed has been established statistically. Perhaps it would not be reasonable to expect that all spores would be dislodged in the time that is practicable to devote to washing a sample, and it is not known how many spores per seed are necessary to cause seedling infection under varying environmental conditions.

It can now be said with considerable certainty that spores of Glomerella gossypii are disseminated from contaminated cotton during ginning and that this is an important factor in the widespread occurrence of this organism as a seedling parasite.

Fairly high spore loads of Fusarium spp. were obtained on all samples from all locations with the exception of 3 ginned samples from Lubbock, Texas, on which none were found. Spores of Diplodia spp. were not found on any of the ginned samples, but small spore loads were obtained on a few seed-cotton (unginned) samples from Florence, South Carolina and Tifton, Georgia. Alternaria spores were found on all unginned samples from the 4 locations and on about 1/2 of the ginned samples. Generally the number of spores per seed was lower on the ginned cotton than on the unginned. Table 12 shows that the average number of spores per seed for the 4 groups of organisms under consideration was considerably higher on the unginned (seed cotton) than on the ginned, although the number of bolls represented in an unginned sample was much lower than in a ginned one. This indicates that most of the spores on seed cotton are removed with the lint during ginning.

The recorded laboratory germination percentages show that generally there were only slight differences in the viability of the seed originating at the 4 locations. The differences, however, in the amount of disease that developed on the seedlings, depending upon the origin of the seed -- Eastern area versus Western -- were significant, and it seems that the differential Glomerella spore loads were largely responsible for these variations. The results of spore load studies conducted during the past 3 years have shown no relation between the size of Glomerella spore loads on a given sample of seed and the percentage germination of the seed. However, the spore load size does seem to influence the amount of post emergence damping-off that results when the seed are planted.

THE PROBABLE EFFECT OF HUMIDITY ON THE SURVIVAL AND SPORULATION OF THE ANTHRACNOSE FUNGUS ON COTTON

Paul R. Miller

The purpose of this study was to obtain information on the possible effect of climatic conditions on the ability of the anthracnose fungus (*Glomerella gossypii*) to survive during the summer and to sporulate. The results tend to show that humidity is an important factor (Table 13 and Figure 2).

Glomerella gossypii-contaminated seed from a common lot of Stoneville 5 variety of cotton was planted at 20 locations indicated in Figure 2. When harvested, this cotton was sent to one place for ginning. Utilizing the technique previously described (P.D.R. 24: 85-92, 1940) anthracnose fungus spore load determinations were made. Results given in Figure 2 show that relatively high spore loads were secured from seed produced at locations in the more humid belt, i.e., in areas near the coast. Generally, low spore loads were obtained from locations in the inland sections of the Eastern cotton belt where somewhat lower humidity prevails. No spores were found on cotton originating in the sub-humid and semi-arid belts of Texas and Oklahoma. Very similar results were obtained when a like study was conducted with seed of the same variety planted in 1939 at most of the same locations.

The distribution of anthracnose indicated in Figure 2 corresponds to that determined during the cotton seedling and boll disease surveys.

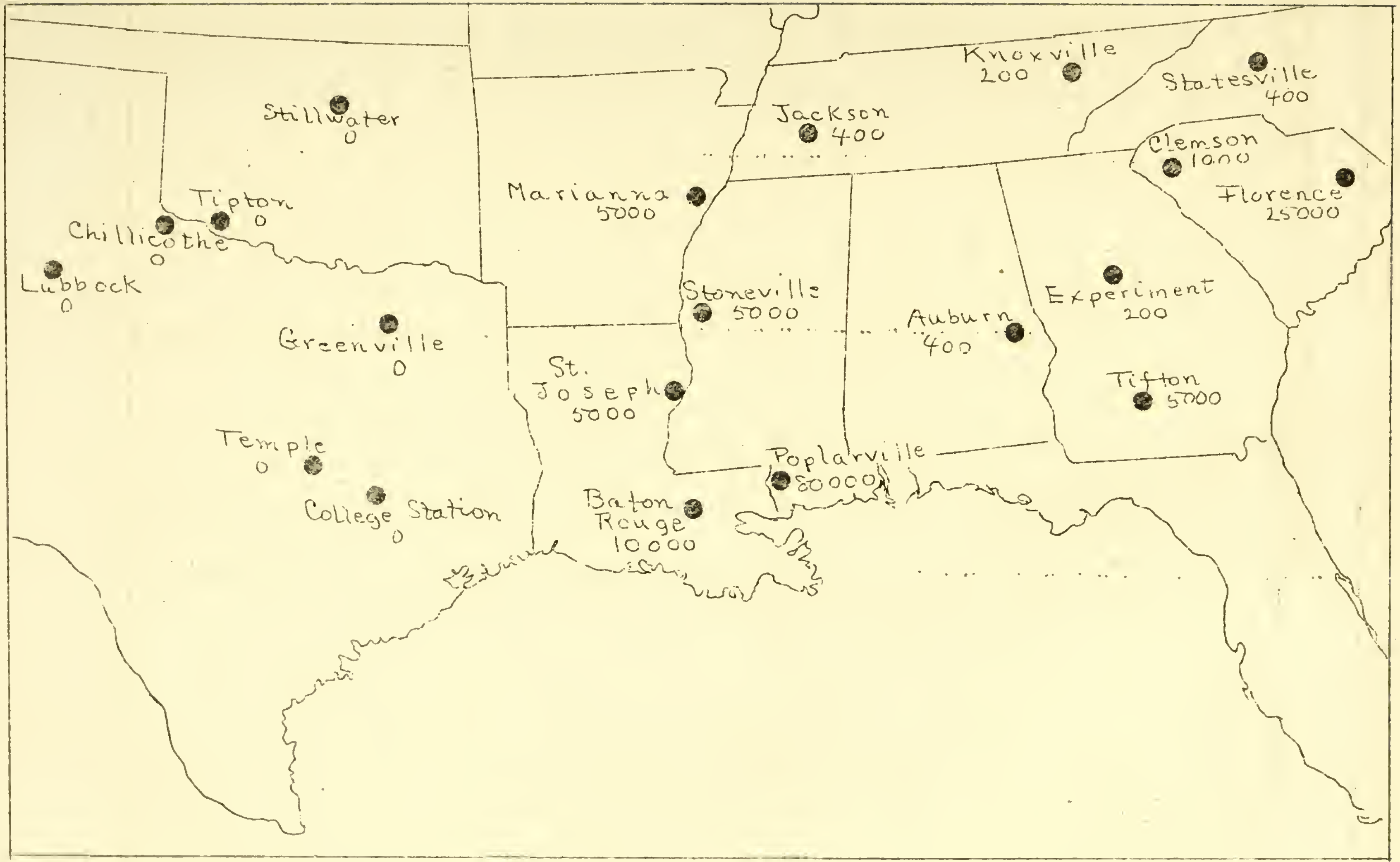

Figure 2. Number of anthracnose (Glomerella gossypii) spores per seed on cotton grown in 1941 from the same seed lot (Stoneville 5) at 20 locations

Table 13. Average Relative Percent Humidity for July [a]

Location	Time of Day		
	8:00 A.M. (EST)	Local Noon	8:00 P.M.(EST)
College Station, Texas	70 - 80	40 - 50	40 - 50
Temple, Texas	70 - 80	40 - 50	40 - 50
Greenville, Texas	70 - 80	50 - 60	50 - 55
Chillicothe, Texas	70 - 80	Under 40	40 - 45
Lubbock, Texas	70 - 80	Under 40	40 - 45
Stillwater, Oklahoma	70 - 80	40 - 50	40 - 50
Tipton, Oklahoma	70 - 80	40 - 50	45 - 50
Clemson, South Carolina	80 - 90	50 - 60	60 - 70
Statesville, North Carolina	80 - 90	50 - 60	60 - 70
Experiment, Georgia	80 - 90	50 - 60	60 - 70
Jackson, Tennessee	80 - 90	50 - 60	60 - 70
Knoxville, Tennessee	80 - 90	50 - 60	60 - 70
Stoneville, Mississippi	85 - 90	60 - 70	60 - 70
Auburn, Alabama	80 - 90	50 - 60	60 - 70
Marianna, Arkansas	85 - 90	50 - 60	60 - 70
St. Joseph, Louisiana	85 - 90	60 - 70	Over 70
Baton Rouge, Louisiana	80 - 90	60 - 70	Over 70
Florence, South Carolina	80 - 90	60 - 70	Over 70
Poplarville, Mississippi	85 - 90	Over 70	Over 70
Tifton, Georgia	80 - 90	60 - 70	Over 70

[a] Based on 200 First Order Weather Bureau Stations - Period 1899 - 1938.

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SUPPLEMENT 142

ANNOTATED CHECK LIST AND HOST INDEX OF THE RUSTS OF GUATEMALA

May 1, 1943

ANNOTATED CHECK LIST AND HOST INDEX OF THE RUSTS OF GUATEMALA [1]

George B. Cummins

Plant Disease Reporter
Supplement 142 May 1, 1943

The first extensive collections of Guatemalan rusts were made by Kellerman from 1905-1908. Most of these records were published by Kern (31, 32). Holway then made three trips to Guatemala between 1914 and 1917. His specimens were studied by Arthur (1, 2, 3). Only occasional collections were made in Guatemala from 1917 until 1937 when Dr. J. R. Johnston began sending specimens of rusts and continued to do so until 1941 when he returned to the United States. In 1939-40 and 1940-41 Paul C. Standley collected many rusts during two Field Museum expeditions to Guatemala. Only selected items of the collections of Johnston and Standley have been published. Since their collections contained numerous rusts and hosts not recorded previously for Guatemala the publication of a complete record of the Guatemalan rusts and their hosts seemed desirable.

In the introduction to his report of Holway's Guatemalan collections Arthur (1) pointed out that not a dozen collections were known aside from those of Kellerman and Holway. In the present account 1858 collections of rusts are cited, comprising 369 species. There are 611 hosts. Of the 1858 specimens of rusts Standley collected 742, Holway 600, Kellerman 243, Johnston 224 and all other collectors only 49.

Both rusts and hosts are alphabetized in a single list. The collections are cited by Departments rather than by localities, the collectors and their numbers are listed but dates of collection are omitted. In case of the "Big Four" only the initial precedes the number. Thus, numbers preceded by H, J, K, or S were collected, respectively, by Holway, Johnston, Kellerman or Standley. Other collectors' names are given in full.

Citations to descriptions are given only for recently described species or for species which have been redescribed or revised. Descriptions of all other species can be found in Volume 7 of the North American Flora.

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[1] Journal Paper Number 79, of the Purdue University Agricultural Experiment Station. Contribution from the Department of Botany.

Map of Guatemala

ABUTILON DISCISSUM (Bertol.) Schl. see NEOBRITTONIA.
ABUTILON GIGANTEUM (Jacq.) Sweet, HIRTUM (Lam.) Sweet: Puccinia heterospora.
ACACIA ANGULOSA Bertol.: Ravenelia igualica.
ACACIA ANGUSTISSIMA (Mill.) Kuntze: Ravenelia leucaenae-microphyllae.
ACACIA BURSARIA Schrenck: Ravenelia inquirenda.
ACACIA FILICICIDES (Cav.) Trel.: Ravenelia igualica.
ACACIA PENNATULA (C. & S.) Benth.: Ravenelia acaciae-pennatulae.
ACALYPHA GUATEMALENSIS Pax & Hoffm.: Uredo antiguensis.
ACHYRANTHES see ALTERNANTHERA.
ACNISTUS ARBORESCENS (L.) Schl.: Puccinia acnisti.
ADENOPETALUM see EUPHORBIA.
ADIANTUM ANDICOLA Liebm: Uredinopsis investita.
AECIDIUM ALBICANS Arth. & Holw., on Phyllanthus conami (P. acuminatus), Escuintla: H 504; Retalhuleu: H 709. Known also from El Salvador, Costa Rica, and Venezuela.
AECIDIUM AMPLIATUM Jacks. & Holw., on Eupatorium sp., Chimaltenango; J 737, 867. Known also from Bolivia and Costa Rica.
AECIDIUM ARCHIBACCHARIDIS Cumm., on Archibaccharis serratifolia, Sacatepéquez: J 79 (type). Known only from the type. For a description see Cummins (13).
AECIDIUM BYRSONIMATIS P. Henn., on Byrsonima crassifolia, Zacapa: K 4325 (type of Aecidium byrsonimae Kern & Kellerm.); B. sp., Izabal (?): Cook. This species differs from the aecia (Aecidium vinnulum Jacks. & Holw.) of Crossopsora notata in having aeciospores with a much thickened apical wall.
AECIDIUM DAHLIAE-MAXONI Cumm., on Dahlia maxoni, Chimaltenango: J 1875 (type). For a description see Cummins (20). Known only from the above collection.
AECIDIUM FUCHSIAE Jacks. & Holw. ? on Fuchsia minutiflora, Chimaltenango: J 1912. This specimen is not typical, having paler peridia and spores with slightly thinner walls, but is best referred to the above species. For a description see Jackson (30). Known otherwise only from South America.
AECIDIUM GUATEMALENSE Kern & Kellerm. on Heliotropium indicum L., Zacapa: K 4326 (type). Known only from Guatemala.
AECIDIUM LANTANAE Mayor, on Lantana involucrata, Chimaltenango: J 686, 736, 769, 861. This species is sometimes included as a synonym of Aecidium verbenae Speg. but with present knowledge that A. verbenae is the aecial stage of Puccinia elongata Speg. (see Thurston, 48) it is best kept separate.
AECIDIUM LORANTHI Thüm., on Psittacanthus calyculatus, locality unknown: Trelease. The specimen is fragmentary and the identity of the rust not too certain.
AECIDIUM LYCIANTHIS Cumm., on Lycianthes quichensis, Chimaltenango: J 1708, 1377 (type); Quezaltenango: S 83365. For a description see Cummins (20).
AECIDIUM SERIATUM Arth., on Euphorbia lancifolia, Alta Verapaz: Pittier 237 (type), S 70520; on E. sp., Izabal: Smyth 64. Reported only from Guatemala.

AECIDIUM TALINI Speg., on Talinum triangulare (Jacq.) Willd., Santa Rosa: S 79497. Known otherwise only from South America. The specimen was compared with Spegazzini's collections by Lindquist. For a description see Sydow (45).

AECIDIUM TOURNEFORTIAE P. Henn., on Tournefortia hirsutissima, El Petén: Lundell 1669; on T. petiolaris DC., Chimaltenango: J 1876.

AEGOPOGON CENCHROIDES H. & B., TENELLUS (Cav.) Trin.: Puccinia aegopogonis.

AESCHYNOMENE sp.: Phakopsora aeschynomenes.

AGERATUM CONYZOIDES L., CORMYBOSUM Zucc. var. LATIFOLIUM (DC.) Rob., RUGOSUM Coult., TOMENTOSUM (Benth.) Hemsl.: Puccinia conoclinii.

AGRIMONIA MACROCARPA (Focke) Rydb.: Pucciniastrum agrimoniae.

AKLEMA see EUPHORBIA.

ALLODUS see PUCCINIA.

ALNUS ACUMINATA H.B.K., ARGUTA (Schl.) Spach, JORULLENSIS H.B.K.: Melampsoridium hiratsukanum.

ALTERNANTHERA OBOVATA (M. & G.) Standl., PHILOXEROIDES Griseb.: Puccinia obesispora.

ALVEOLARIA CORDIAE Lagerh., on Cordia ferruginea, Alta Verapaz: J 1909, S 71852, 91566, 92161; Quezaltenango: S 87980; on C. riparia, Quezaltenango: H 821; on C. sp., Izabal: K 5336. Reported from Central and South America and the West Indies.

AMELANCHIER NERVOSA (Dcne.) Standl.: Gymnosporangium guatemalianum.

AMYGDALUS see PRUNUS.

ANACARDIUM OCCIDENTALE L.: Uredo anacardii.

ANDROPOGON CONDENSATUS H.B.K., Puccinia andropogonis.

ANDROPOGON HIRTIFLORUS (Nees) Kunth: Uromyces clignyi.

ANDROPOGON SACCHAROIDES Sw.: Puccinia infuscans.

ANGIOPSORA COMPRESSA Mains, on Axonopus compressus, Izabal: K 7540; Retalhuleu: S 88773; on Paspalum conjugatum, Izabal: H 594; on P. fasciculatum, Sacatepéquez: S 63343; on P. humboldtianum, Baja Verapaz: K 8034; Chimaltenango: S 80034, 80059; Guatemala: H 64; Huehuetenango: S 82891; Solola: H 129a; on P. squamulatum, Chimaltenango: S 79958. This rust has usually been confused with Puccinia substriata (P. tubulosa), which occurs on the same hosts, but is quite different in all characters. It is common in tropical regions of the Americas. Synonymy, hosts and distribution were published recently by Cummins (18). For illustrations see Arthur (4) who published the species as Puccinia compressa Arth. & Holw., a nonvalid name, and Mains (35).

ANGIOPSORA LENTICULARIS Mains, on Lasiacis divaricata, Guatemala: K 5376; on L. ruscifolia, Santa Rosa: S 77899; on Panicum arundinariae, Chimaltenango: S 81037. Both uredia and telia are present on the Panicum and differ in no way from those on Lasiacis. For a description and illustrations see Mains (35).

ANGIOPSORA PALLESCENS (Arth.) Mains, on Euchlaena mexicana, Guatemala: S 92861; on Tripsacum latifolium, Santa Rosa: K 7802; on T. laxum, unknown locality, Grant 39. For synonymy and illustrations see Mains (35).

ANGIOPSORA ZEAE Mains, on Zea mays L., Chimaltenango: J (type). For a description see Mains (37); for illustrations see Mains (37) and Cummins (17).

ANNONA CHERIMOLIA Mill.: Phakopsora cherimoliae.

ANODA CRISTATA (L.) Schl.: Puccinia anodae, P. heterospora.

ANODA HASTATA Cav.: Puccinia anodae.

ANTHEPHORA HERMAPHRODITA (L.) Kuntze: Puccinia chaseana.

ANTIRRHINUM MAJUS L.: Puccinia antirrhini.

ARBUTUS XALAPENSIS H.B.K.: Pucciniastrum sparsum.

ARCHIBACCHARIS ASPERIFOLIA (Benth.) Blake: Puccinia oaxacana.

ARCHIBACCHARIS SERRATIFOLIA (H.B.K.) Blake: Aecidium archibaccharidis.

ARCHIBACCHARIS TORQUIS Blake: Puccinia oaxacana.

ARDISIA PASCHALIS D. Sm.: Uromyces myrsines.

ARENARIA ALSINOIDES Willd., LANUGINOSA Rohrb.: Puccinia modica.

ARRACACIA BRACTEATA C. & R.: Puccinia arracachae, P. repentina.

ARRACACIA RIGIDA C. & R.: Puccinia arracachae.

ARTHROSTYLIDIUM RACEMIFLORUM Steud.: Uredo ignava.

ASCLEPIAS CURASSAVICA L., GUATEMALENSIS D. Sm.: Uromyces asclepiadis.

ASTER BULLATUS Klatt: Puccinia asteris.

ASTRAGALUS GUATEMALENSIS Hemsl.: Uromyces punctatus.

AVENA SATIVA L.: Puccinia coronata.

AXONOPUS COMPRESSUS (Sw.) Beauv.: Angiopsora compressa.

BACCHARIS GLUTINOSA Pers.: Puccinia baccharidis.

BACCHARIS HETEROPHYLLA H.B.K.: Puccinia interjecta.

BACCHARIS KELLERMANII Greenm.: Puccinia baccharidis-multiflorae.

BACCHARIS LANCIFOLIA Less.: Puccinia interjecta.

BACCHARIS RHEXIOIDES H.B.K.: Puccinia exornata.

BACCHARIS SERRAEFOLIA Benth.: Puccinia baccharidis-multiflorae.

BACCHARIS THESIOIDES H.B.K.: Puccinia exornata.

BACCHARIS TRINERVIS (Lam.) Pers.: Puccinia alia, P. exornata.

BACCHARIS VACCINIOIDES H.B.K.: Puccinia interjecta.

BAEODROMUS EUPATORII Arth., on Eupatorium aschenbornianum, Alta Verapaz: J 1908, S 69250, 89793, 90394; Chimaltenango: J 370, 685, S 57773, 64311, 79814; Guatemala: H 478, 484; Quezaltenango: H 100, 792, S 83559, 85133, 85775, 85811; Sacatepéquez: J 881; on E. donnell-smithii, Alta Verapaz: von Turckheim 927; on E. mairetianum, Quezaltenango: S 83809, on E. pycnocephalum, Chimaltenango: S 79942; Quezaltenango: S 84277, on E. sp., Chimaltenango: J 869; Guatemala: H 16, K 5344; Jalapa: K 7960; Quezaltenango: S 84347; Sacatepéquez: K 7237; San Marcos: S 85297; Sololá: K 5430. Described and known otherwise with certainty only from Mexico. This species should not be confused with Pucciniosira eupatorii.

BAEODROMUS HOLWAYI Arth., on Senecio warscewiczii, Quezaltenango: S 84176. This is an uncommon species, known otherwise from two collections made in Mexico.

BALTIMORA RECTA L.: Uromyces cucullatus.

BAMBUSA VULGARIS Schrad.: Uredo ignava.

BAUHINIA INERMIS Pers., PAULETIA Pers., UNGULATA L.: *Uromyces guatemalensis*.
BEGONIA sp.: *Coleosporium begoniae*.
BENTHAMANTHA CINEREA (L.) Kuntze, MOLLIS (H.B.K.) Alef.: *Phragmopyxis deglubens*.
BERBERIS FASCICULARIS (DC.) Sims.: *Cumminsiella standleyana*, *Puccinia berberidis-trifoliae*.
BIDENS HETEROPHYLLA Ort., HOLWAYI Sheriff & Blake, LEUCANTHA L.: *Uromyces bidenticola*.
BIDENS PILOSA L.: *Uromyces bidenticola*, *U. bidentis*.
BIDENS RIPARIA H.B.K.: *Uromyces bidentis*.
BIDENS SQUARROSA H.B.K., TRIPLINERVIA H.B.K.: *Uromyces bidenticola*.
BITZEA INGAE (Syd.) Mains, on *Inga edulis*, Jutiapa: S 76293; on *I. micheliana*, Alta Verapaz: S 69551, 71504; Escuintla: J; on *I. spuria*, Santa Rosa: S 78424. This species was long classified as a *Ravenelia*, the telia being overlooked when present. Sydow first described the telial stage, but under the name of *Maravalia ingae*. For a description of the genus *Bitzea* see Mains (38).
BIVONEA see JATROPHA.
BLECHUM BROWNEI (Sw.) Juss.: *Puccinia ruelliae*.
BOMAREA ACUTIFOLIA Herb., CALDASII (H.B.K.) Standl.: *Puccinia pallor*.
BORRERIA LAEVIS (Lam.) Griseb., OCYMOIDES (Burm.) DC., SUAVEOLENS Mey., VERTICILLATA (L.) Mey.: *Puccinia lateritia*.
BOUTELOUA FILIFORMIS (Fourn.) Griff.: *Puccinia bartholomaei*.
BOUVARDIA LEIANTHA Benth.: *Uromyces bouvardiae* Syd.
BRACHYPODIUM MEXICANUM (R. & S.) Link: *Puccinia subdigitata*.
BRICKELLIA ADENOCARPA Rob., CAVANILLESII Gray: *Pucciniosira brickelliae*.
BRICKELLIA SCOPARIA (DC.) Gray: *Puccinia kuhniae*.
BROGNIARTIA sp. = error for LONCHOCARPUS RUGOSUS.
BUBAKIA MEXICANA Arth., on *Croton draco*, Jutiapa: S 76291; on *C. payaquensis*, Jutiapa: S 75225. Known otherwise from three Mexican specimens. The wall of the urediospores is strongly thickened at the apex.
BUETTNERIA LATERALIS Presl: *Puccinia filopes*.
BULLARIA see PUCCINIA.
BUNCHOSIA sp.: *Puccinia sanguinolenta*.
BYRSONIMA CRASSIFOLIA (L.) DC.: *Aecidium byrsonimatis*, *Crossopsora notata*.
CACALIA CALOTRICHA Blake: *Puccinia senecionicola*.
CAESALPINIA EXOSTEMMA Moc. & Sessé: *Ravenelia inconspicua*.
CAESALPINIA PULCHERRIMA (L.) Sw.: *Ravenelia humphreyana*.
CALEA INSIGNIS Blake, INTEGRIFOLIA (DC.) Hemsl.: *Puccinia ordinata*.
CALEA ZACATECHICHI Schl.: *Puccinia caleae*.
CALLIANDRA CHAPADERCANA (B. & R.): *Ravenelia ectypa*.
CALLIANDRA CONZATTIANA (B. & R.): *Uredo quichensis*.
CALLIANDRA GRACILIS Klotsch: *Ravenelia ectypa*.
CALLIANDRA HOUSTONIANA (Mill.) Standl.: *Ravenelia bizonata*.
CALLIOSPORA see UROPYXIS.

CALOPOGONIUM GALACTIOIDES (H.B.K.) Benth.: *Uromyces calopogonii*.
CANAVALIA VILLOSA Benth.: *Phakopsora vignae*.
CANNA INDICA L.: *Puccinia cannae*.
CAPSICUM ANNUUM L.: *Puccinia paulensis*.
CARDIOSPERMUM COLUTEOIDES H.B.K., CORINDUM L., GRANDIFLORUM Sw.: *Puccinia arechavaletae*.
CAREX POLYSTACHYA Wahl.: *Puccinia caricis-polystachyae*.
CASSIA BIFLORA L.: *Ravenelia antiguana*, *R. spinulosa*.
CASSIA NICARAGUENSIS Benth.: *Ravenelia spinulosa*.
CASTILLEJA COMMUNIS Benth.: *Puccinia nesodes*.
CASTILLEJA INTEGRIFOLIA L.: *Cronartium coleosporioides*.
CASTILLEJA TENUIFLORA Benth.: *Cronartium coleosporioides*, *Puccinia nesodes*.
CAYAPONIA RACEMOSA (Sw.) Cogn.: *Uromyces hellerianus*.
CENCHRUS ECHINATUS L., PILOSUS H.B.K., VIRIDIS Spreng.: *Puccinia cenchri*.
CENTAUREA CYANUS L.: *Puccinia cyani*.
CEROTELIUM FICI (Cast.) Arth., on *Ficus carica*, Chimaltenango: S 80812; Huehuetenango: S 82743; Retalhuleu: S 87783; Sacatepéquez; S 65284; on *Morus insignis*, Chimaltenango: S 79987. This is a common tropical rust but usually present as uredia. Telia have not been found in the Americas. Related hosts will be found under *Uredo ficina*, which has frequently been confused with *C. fici*.
CESTRUM AURANTIACUM Lindl., GUATEMALENSE Francey: *Uromyces cestri*.
CESTRUM LANATUM M. & G.: *Uromyces maculans*.
CHAMAESYCE see EUPHORBIA.
CHRYSOMYXA PYROLAE (DC.) Rostr., on *Pyrola secunda* var. *elatior*, Quezaltenango: Steyermark 34776. The specimen is scant but the rust undoubtedly is *C. pyrolae* although *Picea*, the alternate host, does not occur south of the United States. The species has not been recorded previously south of New Mexico.
CIONOTHRIX PRAELONGA (Wint.) Arth., on *Eupatorium morifolium* (*E. populifolium*), Guatemala: H 491, 688, 840; Izabal: K 5301, 5302; on *E. odoratum*, Jutiapa: S 78478; Suchitepéquez: H 525; on *E.* sp., Alta Verapaz: S 70665. This *Cronartium*-like microcyclic rust is common in tropical regions of the Americas.
CIRSIUM MEXICANUM DC., SUBCORIACEUM (Less.) Sch. Bip.: *Puccinia cirsii*.
CISSUS RHOMBIFOLIA Vahl.: *Crossopsora wilsoniana*.
CISSUS SICYOIDES L.: *Endophyllum circumscriptum*.
CLEMATIS DIOICA L.: *Puccinia wattiana*.
CLETHRA LANATA M. & G.: *Puccinia hiascens*.
CLIBADIUM DONNELL-SMITHII Coult.: *Endophyllum decoloratum*.
COLEOSANTHUS see BRICKELLIA.
COLEOSPORIUM BEGONIAE Arth., on *Begonia* sp., Chimaltenango: J 232. Known otherwise only from Mexico.
COLEOSPORIUM DOMINGENSIS see COLEOSPORIUM PLUMIERAE.
COLEOSPORIUM ELEPHANTOPODIS (Schw.) Thüm., on *Elephantopus hypomalacus*, Retalhuleu: H 704; on *E. mollis*, Alta Verapaz: S 89716, J 1910; Izabal: K 5362, S 73055; Jalapa: S 76689, 77104; Jutiapa:

S 75465; Quezaltenango: S 87954; Retalhuleu: S 66754. The aecial stage, which occurs on the genus Pinus has not been collected in Guatemala.

COLEOSPORIUM EUPATORII Arth., on Eupatorium collinum, Chimaltenango: S 79731; Huehuetenango: H 758; Quezaltenango: K 5458; Sacatepéquez: S 60757; on E. sp., Chimaltenango: H 659; Quezaltenango: H 812, K 5417. Known only from tropical regions of North America. The aecial stage is unknown.

COLEOSPORIUM IPOMOEAE (Schw.) Burr., on Ipomoea glabriuscula, Guatemala: H 471; on I. hederacea, Guatemala: K 5405, 5409; on I. macrocalyx, Guatemala: K 5408, 5450; on I. morelii, Santa Rosa: S 77745; on I. muricata, Guatemala: H 1; on I. murucoides, Jutiapa: S 75059; Sacatepéquez: S 63852; on I. nil, Guatemala: S 59699; Jalapa: S 76509; Jutiapa: S 75888; Santa Rosa: S 77669, 78237, 79717; on I. parasitica, Jutiapa: S 75264; on I. petri, Guatemala: H 619; Solola: H 181; on I. purpurea, Chimaltenango: S 80114; Sacatepéquez: S 58015, 63174; on I. tyrianthina, Guatemala: K 5435; on I. sp., Chimaltenango: S 80105; Jutiapa: S 75178, 75346; Quezaltenango: S 83710, 84839, 84863; Santa Rosa: S 77677, 79426; on Quamoclit coccinea, Chimaltenango: S 79916; Jalapa: S 77272; Sacatepéquez: S 59819. This is a species of wide distribution in North and South America. The aecial stage on Pinus has not been found in Guatemala.

COLEOSPORIUM PARAPHYSATUM Diet. & Holw., on Liabum discolor, Alta Verapaz: S 89749, 90456; Chimaltenango: S 80194; Guatemala: K 6298; Quezaltenango: S 85017; Sacatepéquez; S 60321, 60818; San Marcos: S 66272; on L. hypochlorum, Retalhuleu: H 703; on L. hypoleucum, Chimaltenango: S 79835; Jalapa: S 77537; Sacatepéquez: S 81014; Santa Rosa: S 77681, 77780, 79352; on L. platylepis, Alta Verapaz: S 70441; on L. sublobatum, Chimaltenango: S 80131; Retalhuleu: H 532; Solola: H 179; on L. sp., Retalhuleu: H 690. An interesting species because of the peridiate uredia and long narrow urediospores. The aecial stage is not known. Reported also from Costa Rica, El Salvador, and Mexico.

COLEOSPORIUM PLUMIERAE Pat., on Plumiera acutifolia ?, Solola: K; on P. lutea, Quezaltenango: Donnell-Smith; on P. rubra, Quezaltenango: K 5460. Known also from Panama, the West Indies, and South America. The aecial stage is unknown.

COLEOSPORIUM SPIGELIAE Arth., on Spigelia humboldtiana, Izabal: S 23933. Known otherwise from British Honduras, El Salvador, and Mexico. The aecial stage is unknown.

COLEOSPORIUM STEVIAE Arth., on Stevia elatior, Chimaltenango: J 246; on S. lucida, Huehuetenango: H 772; El Quiché: J 1455; on S. ovata Willd., Chimaltenango: S 79991; on S. polycephala, Quezaltenango: S 86043; on S. rhombifolia, Chimaltenango: J 135, S 60015; Jalapa: S 77471; on S. subpubescens, Quezaltenango: H 104; on S. sp., Sacatepéquez: J 876. This species also occurs in Mexico. The aecial stage is unknown.

COLEOSPORIUM VIBURNI Arth., on Viburnum discolor, Sacatepéquez: S 65127; on V. sp., Sacatepéquez: H 567, 574. The sori are usually on the leaves but in Standley's collection the fruits are infected. C. viburni occurs northward into Canada. No aecial stage has been recognized.

COLEOSPORIUM VIGUIERAE Diet. & Holw., on Verbesina agricolarum, Chimaltenango: S 79778; on V. apleura, Quezaltenango: H 739; on V. fraseri, Sacatepéquez: J 67, 873; Solola: J 81; on V. gigantea, Solola: K 5385; on V. guatemalensis, Sacatepéquez: J 850, 853; Solola: J 82; on V. holwayi, Quezaltenango: H 737; on V. hypoglauca, Chimaltenango: S 61833; Quezaltenango: Steyermark 34101, S 67658; on V. myriocephala, Jutiapa; S 75210; on V. perymenioides, Solola: H 172; on V. punctata, San Marcos: S 66263; on V. scabriuscula, Chimaltenango: S 80014; Jalapa: S 77233; Quezaltenango: S 84974, 86134, 87092; Retalhuleu: H 723; San Marcos: S 86266; on V. sublobata, Chimaltenango: J 1929; Escuintla: S 64920; Guatemala: H 51; Quezaltenango: S 84310, 84727, 85606, 87950; Sacatepéquez: S 61244; Santa Rosa: S 79372; Solola: H 175B; on V. turbacensis, Alta Verapaz: S 70264; Chimaltenango: S 79773; Chiquimula: S 74644; Sacatepéquez: S 58593; locality unknown: K 5315; on V. sp., Quezaltenango: S 83449; Sacatepéquez: H 575, J 70a; Santa Rosa: J. Common in Guatemala and the warmer regions of North America. The aecial stage is unknown.

COLOGANIA GLABRIOR Rose: Uromyces cologaniae.

COLUBRINA FERRUGINOSA Brongn.: Uredo colubrinae.

COMMELINA ELEGANS H.B.K.: Phakopsora tecta, Puccinia commelinae.

CONYZA ASPERIFOLIA, TORQUIS see ARCHIBACCHARIS.

CORDIA ALLIODORA (R. & P.) Cham.: Puccinia cordiae.

CORDIA FERRUGINEA (Lam.) R. & S., RIPARIA H.B.K.: Alveolaria cordiae.

COREOPSIS MUTICA DC.: Puccinia electrae.

CORNUTIA GRANDIFOLIA (S. & C.) Schauer: Puccinia urbaniana.

CRONARTIUM COLEOSPORIOIDES (Diet. & Holw.) Arth., on Castilleja integrifolia, Quezaltenango: S 83414; on C. tenuiflora, Quezaltenango: H 788; Sacatepéquez: H 644; Solola: H 125a; on C. sp., Quezaltenango: H 726; Lamourouxia cordifolia, Guatemala: H 685; on L. dependens, Sacatepéquez: H 568; on L. rhinanthifolia, Quezaltenango: H 101; on Pinus sp., Chimaltenango: J. Occurs northward into the United States. The aecial stage on Pinus corresponds to Peridermium filamentosum Peck.

CRONARTIUM HARKNESSII see CRONARTIUM COLEOSPORIOIDES.

CRONARTIUM QUERCUUM (Berk.) Miyabe sens. lat., on Pinus montezumae, Chimaltenango: S 64354; Huehuetenango: S 82349; Jalapa: S 76740; on P. oocarpa, Baja Verapaz: S 69720; Izabal ?: Cook; on P. sp., Alta Verapaz: S 71043; Baja Verapaz: K 6075; Chimaltenango: J 644: on Quercus corrugata, Chimaltenango: J 349; on Q. tomentosa, Guatemala: K 5304; on Q. sp., Guatemala: H 56, 866. In the aecial stages both cone-infecting and branch-infecting forms are represented. No attempt has

been made to segregate these into the separate species to which they might be referable, although the material is probably heterogeneous. A widely distributed species.

CROSSOPSORA NOTATA Arth., on Byrsonima crassifolia, Jutiapa: J. This collection has aecia and uredia in close association. The aecia agree with Aecidium vinnulum, Jacks. & Holw., thus substantiating Jackson's (28) suggestion that the species might represent the aecial stage of C. notata. Known from Central and South America and the West Indies.

CROSSOPSORA STEVENSII Syd., on Fischera sp., Zacapa: K; on Macroscepsis sp., Zacapa: K 7022; on Mandevilla subsagittata, Santa Rosa: S 77952. This rust was first reported from Guatemala by Davidson (21) as on Fischera sp. The host of a specimen in the Arthur Herbarium was determined by J. M. Greenman as Macroscepsis sp. Both records are cited above, although they are probably from the same collection. For a description see Sydow (43). Known otherwise from British Guiana and Trinidad.

CROSSOPSORA WILSONIANA Arth., on Cissus rhombifolia, Izabal: K 5340. This is the first report of this rust from Guatemala. The specimen was found in a box of unidentified Kellerman collections in the Arthur Herbarium. Known from Central and South America and the West Indies.

CROTALARIA LONGIROSTRATA H. & A., VITELLINA Ker.: Haplopyxis crotalariae.

CROTON DRACO Schlect., PAYAQUENSIS Standl.: Bubakia mexicana.

CRUSEA CALOCEPHALA DC.: Puccinia lateritia.

CUCURBITACEAE (undet.): Uromyces hellerianus.

CUMMINSIELLA STANDLEYANA Cumm., on Berberis fascicularis, Huehuetenango: J 1690a, S 81803, 81819a; Sacatepéquez: K 4624, S 65222. The Kellerman specimen has previously passed as C. sanguinea (Uropyxis sanguinea), a species which does not occur in Guatemala. C. standleyana is known only from the above collections. For descriptions of the telial and aecial stages, respectively, see Cummins (15, 20).

CUNILA LEUCANTHA Benth., POLYANTHA Benth.: Puccinia fuscata.

CUPHEA AEQUIPETALA Cav., APPENDICULATA Benth., AXILLIFLORA Koehne: Puccinia cupheae.

CUPHEA HOOKERIANA Walp.: Puccinia jaliscensis.

CUPRESSUS BENTHAMI Endl.: Gymnosporangium meridissimum.

CYDISTA sp.: Prospodium cydistae.

CYNODON DACTYLON (L.) Pers.: Puccinia cynodontis.

CYPERUS FERAX Rich.: Puccinia cyperi, P. flavo-virens.

CYPERUS HERMAPHRODITUS (Jacq.) Standl., INCOMPLETUS (Jacq.) Link: Puccinia cyperi.

CYPERUS MELANOSTACHYUS H.B.K.: Uredo obnixa.

CYPERUS MEYENIANUS Kunth: Puccinia canaliculata.

DAHLIA MAXONI Saff.: Aecidium dahliae-maxoni.

DAHLBERGIA GLABRA (Mill.) Standl.: Sphaerophragmium fimbriatum.

DALEA see PAROSELA.

DASYSPORA GREGARIA (Kunze) P. Henn.: on Xylopia frutescens, Izabal: K 5330, S 72261; El Petén: Lundell 2557A. This species is often cited as D. foveolata B. & C. Mains (36) has recently discussed this rust and published photographs of the spore stages. Known also from British Honduras, Costa Rica, Panama, and South America.

DESMELLA SUPERFICIALIS (Speg.) Syd., on Trismeria trifoliata, Escuintla: S 60154. The morphology of the sori of Desmella has been described and illustrated by Cummins (14). D. superficialis occurs rather generally in tropical regions of the Americas on several ferns. Telia have not been collected on Trismeria.

DESMODIUM ANGUSTIFOLIUM Schl.: Uromyces hedysari-paniculati.

DESMODIUM INTORTUM (Mill.) Fawc. & Rendle: Phakopsora meibomiae, Uromyces hedysari-paniculati.

DESMODIUM ORBICULARE Schl.: Uromyces antiguanus.

DESMODIUM SCORPIURUS (Sw.) Desv., STROBILACEUM Schl., TENUIPES Blake: Uromyces hedysari-paniculati.

DICAEOMA see PUCCINIA.

DICHEIRINIA BINATA (Berk.) Arth., on Erythrina glauca, Izabal: K 5465 (type of Uredo cabreriana Kern & Kellerm.). Recorded for Central and South America and the West Indies. In 1935 Cummins (8) reviewed and illustrated the four species of Dicheirinia known at that time. Three species have been added since.

DICHONDRA SERICEA Sw.: Puccinia dichondrae.

DICHROMENA CILIATA Vahl., RADICANS S. & C.: Puccinia dichromenae.

DIODIA SARMENTOSA Sw., TERES Walt.: Puccinia lateritia.

DIPHYSA FLORIBUNDA Peyr., ROBINIOIDES Benth.: Uropyxis diphysae.

DORSTENIA CONTRAJERVA L., HOUSTONI L.: Uredo rubescens.

DYSCHORISTE QUADRANGULARIS (Oerst.) Kuntze: Puccinia dyschoristes.

ELEOCHARIS GENICULATA (L.) R. Br.: Puccinia liberta.

ELEOCHARIS sp.: Puccinia liberta, Uredo incomposita.

ELEPHANTOPUS HYPOMALACUS Blake, MOLLIS H.B.K.: Coleosporium elephantopodis.

ELEUTHERANTHERA RUDERALIS (Sw.) Sch. Bip.: Puccinia spegazziniana.

ELYTRARIA IMBRICATA (Vahl.) Pers.: Puccinia elytrariae.

ENDOPHYLLOIDES PORTORICENSIS Whetzel & Olive, on Mikania cordifolia, Retalhuleu: H 538; on M. micrantha, Escuintla: S 60147; Izabal: S 24084, 72494, 72582; Retalhuleu: S 87859, 88386; on M. scandens, Alta Verapaz: Maxon & Hay 3239; Izabal: K 5307, 5349, 7465; on M. sp., Escuintla: J 1692; Izabal: H 603, K 5370, S 24084. Reported from Central and South America and the West Indies.

ENDOPHYLLUM CIRCUMSCRIPTUM (Schw.) Whetzel & Olive, on Cissus sicyoides, Izabal: K 5335, K 5463, S 23870; Retalhuleu: S 88244; Sacatepéquez: J 1923; Suchitepéquez: K 4609; Zacapa: K 5440, 5462; on C. sp., Izabal: H 596; Retalhuleu: H 695, 720. Reported from Central and South America and the West Indies.

ENDOPHYLLUM DECOLORATUM (Schw.) Whetzel & Olive, on Clibadium donnell-smithii, Guatemala: Donnell-Smith. Reported from Mexico, the West Indies, and South America.
ENTADA sp.: Ravenelia entadae.
EPICAMPIS MACROURA (H.B.K.) Benth.: Uromyces epicampis.
ERAGROSTIS LIMBATA Fourn.: Uromyces eragrostidis.
EREMOSIS see VERNONIA.
ERIGERON BONARIENSIS L., DEAMII Rob., KARVINSKIANUS DC., SPATHULATUS Vahl: Puccinia asteris.
ERIOSPORANGIUM see PUCCINIA.
ERYTHRINA BERTEROANA Urban: Uredo erythrinae.
ERYTHRINA GLAUCA Willd.: Dicheirinia binata.
EUCHLAENA MEXICANA Schrad.: Angiopsora pallescens, Puccinia polysora, P. sorghi.
EUMECANTHUS see EUPHORBIA.
EUPATORIUM ARECLARIA DC.: Puccinia solidipes.
EUPATORIUM ASCHENBORNIANUM Schauer: Baeodromus eupatorii.
EUPATORIUM COLLINUM DC.: Coleosporium eupatorii, Puccinia conoclinii.
EUPATORIUM DONNELL-SMITHII Coult.: Baeodromus eupatorii.
EUPATORIUM GLANDULOSUM H.B.K.: Puccinia conoclinii.
EUPATORIUM LIGUSTRINA DC.: Puccinia aegopogonis.
EUPATORIUM MAIRETIANUM DC.: Baeodromus eupatorii, Puccinia aegopogonis, P. basiporula.
EUPATORIUM MORIFOLIUM Mill.: Cionothrix praelonga.
EUPATORIUM NEAEANUM DC.: Puccinia conoclinii.
EUPATORIUM ODORATUM L.: Cionothrix praelonga.
EUPATORIUM ORESBIOIDES Rob.: Puccinia conoclinii.
EUPATORIUM PANSAMALENSIS Rob.: Puccinia tolimensis.
EUPATORIUM PHOENICOLEPIS Rob.: Puccinia basiporula, P. hogsoniana.
EUPATORIUM PYCNOCEPHALOIDES Rob.: Puccinia conoclinii, P. tolimensis.
EUPATORIUM PYCNOCEPHALUM Less.: Baeodromus eupatorii, Puccinia conoclinii, P. tolimensis.
EUPATORIUM RAFAELENSE Coult.: Puccinia aegopogonis, P. basiporula.
EUPATORIUM SCHULTZII Schnittsp. vars.: Puccinia hogsoniana.
EUPATORIUM TUBIFLORUM Benth. see E. ARECLARIA.
EUPATORIUM sp.: Aecidium ampliatum, Pucciniosira eupatorii.
EUPHORBIA ADENOPTERA Bertol., BRASILIENSIS Lam.: Uromyces proëminens.
EUPHORBIA CARACASANA Kl. & Gke., COTINIFOLIA L.: Puccinia euphorbiae var. longipes.
EUPHORBIA EPHEDROMORPHA Bartlett: Puccinia velata.
EUPHORBIA GRAMINEA Jacq.: Puccinia velata, Uromyces proëminens.
EUPHORBIA HIRTA L.: Uromyces proëminens.
EUPHORBIA LANCIFOLIA Schl.: Aecidium seriatum.
EUPHORBIA LASIOCARPA Klotzsch: Uromyces proëminens.
EUPHORBIA SCOTANA Boiss. see E. cotinifolia.
EUPHORBIA THYMIFOLIA L.: Uromyces proëminens.
EVOLVULUS ALSINOIDES L., NUMMULARIA L.: Puccinia lithospermi.
EYSENHARDTIA ADENOSTYLIS Baill.: Uropyxis holwayi.
FICUS AUREA Nutt.: Uredo ficina.
FICUS CARICA L.: Cerotelium fici.

FICUS INVOLUTA (Liebm.) Miq., PADIFOLIA H.B.K.: Uredo ficina.
FISCHERIA sp.: Crossopsora stevensii.
FUCHSIA CHIAPENSIS Brandeg., MICROPHYLLA H.B.K.: Puccinia fuchsiae.
FUCHSIA MINUTIFLORA Hemsl.: Aecidium fuchsiae.
FUCHSIA SPLENDENS Zucc.: Pucciniastrum fuchsiae.
FUIRENA INCOMPLETA Nees.: Puccinia fuirenae.
FUNASTRUM CRASSIFOLIUM (Hemsl.) Schlecter: Puccinia obliqua.
GALIUM MEXICANUM H.B.K.: Puccinia eximia.
GALIUM sp.: Puccinia eximia, P. punctata.
GAYA CALYPTRATA (Cav.) H.B.K.: Puccinia heterospora.
GERASCANTHUS see CORDIA.
GNAPHALIUM ATTENUATUM DC., LEPTOPHYLLUM DC., OXYPHYLLUM DC.:
Puccinia investita.
GNAPHALIUM RHODANTHUM Sch. Bip.: Puccinia gnaphalii.
GOMPHRENA TUERCKHEIMII (Vatke) Uline & Bray: Uromyces bonariensis.
GONOLOBUS sp.: Puccinia obliqua.
GOUANIA DOMINGENSIS L.: Uromyces gouaniae.
GOUANIA LUPULOIDES (L.) Urban: Puccinia gouaniae, P. invaginata.
GOUANIA POLYGAMA (Jacq.) Urban: Puccinia gouaniae.
GYMNOLOMIA see HYMENOSTEPHIUM.

GYMNOSPORANGIUM GUATEMALIANUM Crowell, on Amelanchier nervosa, Sacatepéquez: S 59952; Chimaltenango: J 1444 (type). The telial stage of this rust has not been demonstrated but see note under G. meridissimum. For a description and illustration see Crowell (7). Known only from the above collections.

GYMNOSPORANGIUM MERIDISSIMUM Crowell, on Cupressus benthami, Chimaltenango: J (type); Sacatepéquez: S 60291. This species causes fusiform galls on branches and trunks. Johnston (in litt.) writes "---- it is very abundant here, and I consider it really of economic importance. Cypress is used here extensively as a timber tree and these knots frequently spoil the trunks of young trees ----." The aecial stage has not been demonstrated but since both this species and G. guatemalianum on Amelanchier occur in the same region it is possible that they represent telial and aecial stages of the same rust. For a description and illustration see Crowell (7). Known only from the above collections.

GYMNOSPORANGIUM SPECIOSUM Peck, on Juniperus mexicana, Huehuetenango: Dodge, S 81737. For discussion and a photograph of an infected tree see Cummins (20). However, since that note was written I have received from Dr. C. W. Dodge a specimen which he collected in May 1941 and which bears an abundance of telia. He wrote: "I am sending you --- a very striking Gymnosporangium on Juniperus mexicana. It produced large ribbon-like structures 10 to 15 centimeters long and 2 to 3 centimeters wide, hanging from the trunks and larger branches." The teliospores are from 1 - 4-celled and measure 16-24 x 53-135 (-145) µ. Examination of specimens of G. speciosum shows that the species is more variable than is indicated by published descriptions. The teliospores of the type are 2 - 3-celled and reach 80 µ in length. In a

specimen from Arizona the teliospores reach 119 µ and in a specimen from New Mexico (Barth., N. Am. Ured. 3424) they reach 102 µ in length. In both 4-celled spores occur. A few 1-celled spores can be found in most collections. The Guatemalan collections were all made in the Cuchumatanes Mts. Mr. Standley has advised me that although the Field Museum has no specimens of the aecial host genus, Philadelphus, from the Cuchumatanes he has no doubt that P. myrtoides does occur there. There is little doubt but that the Guatemalan rust should be referred to G. speciosum.

HACKELIA MEXICANA (C. & S.) I. M. Johnst.: Puccinia hackeliae.

HAPLOPYXIS CROTALARIAE (Arth.) Syd., on Crotalaria longirostrata, Guatemala: K 5327; on C. vitellina, Guatemala: K 5397 (type of Uropyxis crotalariae Arth.); Santa Rosa: S-77855. This is the only species in the genus. Haplopyxis has the characteristics of the genus Uropyxis but with unicellular teliospores. Known otherwise from Brazil.

HELIANTHUS ANNUUS L.: Puccinia helianthi.

HELICONIA sp.: Puccinia heliconiae.

HELIOCARPUS sp.: Pucciniosira pallidula.

HELIOTROPIUM INDICUM L.: Aecidium guatemalense, Puccinia heliotropii.

HELIOTROPIUM PHYSOCALICINUM Donn. Sm., RUFIPILUM (Benth.) I. M. Johnst.: Puccinia gilva.

HEMIBACCHARIS see ARCHIBACCHARIS.

HENRYA IMBRICANS Donn. Sm.: Puccinia henryae.

HETEROPTERIS LAURIFOLIA (L.) Juss.: Puccinia laurifoliae.

HIERACIUM ABSCISSUM Less.: Puccinia hieracii.

HYDROCOTYLE BONARIENSIS Lam., MEXICANA C. & S., UMBELLATA L.: Puccinia hydrocotyles.

HYMENOSTEPHIUM CORDATUM (H. & A.) Blake: Puccinia gymnolomiae, P. semota.

HYMENOSTEPHIUM MICROCEPHALUM (Less.) Blake: Puccinia gymnolomiae.

HYPERICUM PRATENSE C. & S.: Uromyces hyperici.

HYPTIS BREVIPES Poit., CAPITATA Jacq.: Puccinia medellinensis.

HYPTIS LILACINA Schiede & Deppe: Puccinia fidelis.

HYPTIS MUTABILIS (Rich.) Briq.: Puccinia amphiospora, P. hyptidis-mutabilis.

HYPTIS OBLONGIFOLIA Benth.: Puccinia fidelis.

HYPTIS PECTINATA (L.) Poir.: Puccinia fidelis, P. hyptidis, P. medellinensis.

HYPTIS POLYSTACHYA H.B.K.: Puccinia medellinensis.

HYPTIS STELLULATA Benth.: Puccinia parilis.

HYPTIS SUAVEOLENS (L.) Poit.: Puccinia medellinensis.

HYPTIS URTICOIDES H.B.K.: Puccinia fidelis.

IMPERATA BRASILIENSIS, error for ANDROPOGON SACCHAROIDES.

INDIGOFERA MUCRONATA Spreng.: Ravenelia indigoferae, Uromyces indigoferae.

INDIGOFERA SUFFRUTICOSA Mill.: Ravenelia indigoferae.

INGA EDULIS Mart.: Bitzea ingae, Uredo ingae.

INGA MICHELIANA Harms, SPURIA H. & B.: Bitzea ingae.
IPOMOEA FISTULOSA Mart.: Puccinia noticolor.
IPOMOEA GLABRIUSCULA House: Coleosporium ipomoeae, Puccinia crassipes.
IPOMOEA HEDERACEA (L.) Jacq., MACROCALYX (R. & P.) Choisy: Coleosporium ipomoeae.
IPOMOEA MORELII Duch. & Walp.: Coleosporium ipomoeae, Puccinia noticolor.
IPOMOEA MURICATA R. & S.: Coleosporium ipomoeae.
IPOMOEA MURUCOIDES R. & S.: Coleosporium ipomoeae, Puccinia noticolor.
IPOMOEA NIL (L.) Roth: Coleosporium ipomoeae.
IPOMOEA PARASITICA (H.B.K.) Don: Coleosporium ipomoeae, Puccinia noticolor.
IPOMOEA PETRI Donn. Sm., PURPUREA (L.) Roth: Coleosporium ipomoeae.
IPOMOEA TILIACEA (Willd.) Choisy, TRIFIDA (H.B.K.) Don., TRILOBA L.: Puccinia crassipes.
IPOMOEA TYRIANTHINA Lindl.: Coleosporium ipomoeae.
IRESINE CALEA (Ibáñez) Standl.: Uromyces celosiae.
IRESINE CELOSIA L.: Uromyces celosiae, U. ictericus.
JACQUEMONTIA NODIFLORA (L.) Desv.: Uromyces gemmatus.
JACOBINIA sp.: Puccinia varia.
JATROPHA CURCAS L.: Phakopsora jatrophicola.
JATROPHA TUBULOSA M. Arg., URENS L.: Uromyces oaxacanus.
JUNCUS EFFUSUS L.: Uromyces junci-effusi.
JUNIPERUS MEXICANUS Spreng.: Gymnosporangium speciosum.
JUSTICIA INAEQUALIS B. & H.: Puccinia ruelliae.
KLEBAHNIA see UROMYCES.
KUEHNEOLA ARTHURI (Syd.) Jacks., on Rubus amplior, Quezaltenango: J 432; on R. schiedeanus, Alta Verapaz: von Tuerckheim (type of Uromyces arthuri Syd.); on R. sp., Quezaltenango: H 832. For a realignment of Rubus rusts previously assigned to Spirechina see Jackson (27). Known only from Guatemala.
KUEHNEOLA GUATEMALENSIS Cumm., on Rubus tuerckheimii, Guatemala: S 80704 (type). This species has apically lobed teliospores like those of K. arthuri but in longer chains and the aeciospores are echinulate. The primary infections cause large galls as in K. loeseneriana and K. arthuri. For a description see Cummins (20).
KUEHNEOLA LOESENERIANA (P. Henn.) Arth., on Rubus sp., Huehuetenango: C. & E. Seler 2687 (type). Known also from Costa Rica and South America.
KUEHNEOLA MALVICOLA (Speg.) Arth., on Malvaviscus arboreus (M. mollis), Guatemala: K 5359; Huehuetenango: H 766; Sacatepéquez: H 543; Suchitepéquez: K 5375; on M. sp., Chimaltenango: J 69. Occurs from the southern United States southward into South America.
KYLLINGA ODORATA Vahl., PUMILA Michx.: Puccinia cyperi.
LAGASCEA HELIANTHIFOLIA var. SUAVEOLENS (H.B.K.) Rob.: Puccinia noccae.
LAMOUROUXIA CORDIFOLIA Schl. & Cham., DEPENDENS Benth., RHINANTHIIFOLIA H.B.K.: Cronartium coleosporioides.

LAMOURCUXIA VISCOSA H.B.K.: Puccinia nesodes.
LANTANA CAMARA L., HISPIDA H.B.K.: Prospodium tuberculatum.
LANTANA INVOLUCRATA L.: Aecidium lantanae, Puccinia lantanae.
LASIACIS DIVARICATA (L.) Hitchc., RUSCIFOLIA (H.B.K.) Hitchc., Angiopsora lenticularis.
LIABUM DISCOLOR (H. & A.) B. & H., HYPOCHLORUM Blake, HYPOLEUCUM Greenm., PLATYLEPIS Sch. Bip., SUBLOBATUM Rob.: Coleosporium paraphysatum.
LIPPIA ASPERIFOLIA Rich., DULCIS Trev.: Prospodium lippiae.
LIPPIA MYRIOCEPHALA S. & C.: Prospodium conjunctum, P. elatipes, P. lippiae, Puccinia senilis.
LIPPIA STRIGOSA Turcz., UMBELLATA Cav.: Prospodium lippiae.
LOESELIA CILIATA L., GLANDULOSA (Cav.) Don: Puccinia fumosa.
LONCHOCARPUS MICHELIANUS Pittier, RUGOSUS Benth.: Ravenelia mera.
LONCHOCARPUS sp.: Ravenelia lonchocarpi.
LOPEZIA HIRSUTA Jacq.: Puccinia fuchsiae, Pucciniastrum fuchsiae.
LORANTHUS see PSITTACANTHUS and STRUTHANTHUS.
LUPINUS FLABELLARIS Bertol, MONTANUS H.B.K.: Uromyces montanus.
LYCIANTHES QUICHENSIS (Coult. & Donn. Sm.) Bitter: Aecidium lycianthis.
LYSILOMA ACAPULCENSIS (Kunth) Benth.: Ravenelia sololensis.
MACHAERIUM BIOVULATUM Mich.: Uredo machaeriicola.
MACROSCEPSIS sp.: Crossopsora stevensii.
MAHONIA see BERBERIS.
MAINSIA EPIPHYLLA (Arth.) Jacks., on Rubus eriocarpus, Quezaltenango: S 84352; Sacatepéquez: S 65167. Known otherwise only from the type collection made in Texas. For a review of the genus Mainsia see Jackson (27).
MAINSIA HOLWAYI Jacks., on Rubus adenotrichus, Chimaltenango: S 64298; on R. irasuensis, San Marcos: S 86456. Originally named and otherwise reported only from South America.
MAINSIA PITTIERIANA (P. Henn.) Jacks., on Rubus sp. Guatemala: K. Reported by Davidson (21) under the generic name Spirechina. Known otherwise only from Costa Rica.
MAINSIA RUBI (Diet. & Holw.) Jacks., on Rubus amplior, Chimaltenango: S 61550; Huehuetenango: S 65755; on R. coriifolius, Totonicapán: S 83996; on R. eriocarpus, Chimaltenango: S 80245; Quezaltenango: S 86140; on R. glaucus, Alta Verapaz: S 90215; Guatemala: K 4625; Sacatepéquez: J 231, K 5319, 5320, 5321; San Marcos: Steyermark 36585; on R. irasuensis, Huehuetenango: S 82002; Quezaltenango: S 83963; Totonicapán: S 84073; San Marcos: S 85288; on R. laxus, Huehuetenango: H 756; on R. misor, Quezaltenango: S 86626; locality unknown: Salas; on R. poliophyllus, Sacatepéquez: K 5363; Solola: K 5415; on R. pringlei, Sacatepéquez: H 80, 559, 560; on R. tuerckheimii, Quezaltenango: S 86120; on R. sp., Chimaltenango: J 376; Guatemala: H 17, 33; Quezaltenango: H 746; Sacatepéquez: J 230. This species, apparently very common in Guatemala, has been reported from Mexico, Costa Rica, and El Salvador. The uredia and telia are extrastomatal.

MAINSIA STANDLEYANA Cumm., on *Rubus irasuensis*, Alta Verapaz: S 91714 (type). This species, known only from the type, has aeciospores with a greatly thickened apical wall and brownish teliospores with slightly thickened apical wall. An illustration accompanies the description (20). It is possible that no uredia are formed. For a review of other species of the genus see Jackson (27).

MALVA SYLVESTRIS L.: *Puccinia heterospora*.

MALVASTRUM COROMANDELIANUM (L.) Garcke: *Puccinia sherardiana*.

MALVAVISCUS ARBOREUS Cav.: *Kuehneola malvicola*, *Puccinia heterospora*.

MANDEVILLA SUBSAGITTATA (R. & P.) Woodson: *Crossopsora stevensii*.

MARAVALIA PRESSA (Arth. & Holw.) Mains, on *Vernonia deppeana*, Alta Verapaz: S 69519; Guatemala: K 4341; Huehuetenango: H 779; Sacatepéquez: S 64277; Solola: H 173. For a review of the genus *Maravalia* consult Mains (39). Known otherwise from Costa Rica.

MARSDENIA MEXICANA Decne.: *Puccinia marsdeniae*.

MEDICAGO LUPULINA L., SATIVA L.: *Uromyces striatus*.

MEIBOMIA see DESMODIUM.

MELAMPODIUM DIVARICATUM (Rich.) DC., LONGIFOLIUM DC.: *Puccinia melampodii*.

MELAMPSORA ABIETI-CAPRAEARUM Tubeuf, on *Salix chilensis*, Chimaltenango: J 68, S 79760, 79957; Huehuetenango: S 82405; Sacatepéquez: H 72, S 64717; Solola: K 5473; Zacapa: S 72100; on *S. taxifolia*, Huehuetenango: H 763. This rust has usually been reported as *M. humboldtiana*, a name which Arthur (6) reduced to synonymy. The aecial stage occurs on the genus *Abies*, which is represented in Guatemala, but has not yet been recorded south of the United States.

MELAMPSORA RIBESII-PURPUREAE Kleb., on *Salix bonplandiana*, Quezaltenango: H 752, S 83943; Sacatepéquez: S 64689. Previous to publication of Arthur's Manual (6) this species was reported in American literature as *M. confluens*. The Holway collection cited above was reported by Arthur (1) as *M. bigelowii*.

MELAMPSORIDIUM CARPINI (Nees) Diet., on *Ostrya virginiana* var. *guatemalensis*, Sacatepéquez: S 58921. *M. carpini* is otherwise known in North America only from northern New York.

MELAMPSORIDIUM HIRATSUKANUM Ito, on *Alnus acuminata*, Solola: H 150; on *A. arguta*, Quezaltenango: S 83919, 84260; on *A. jorullensis*, Guatemala: K; Quezaltenango: H 791; El Quiché: J 1456. In American literature this species has previously been reported as *M. alni*. For distinguishing characteristics and a discussion of the two species see Hiratsuka (23).

MELAMPSOROPSIS see CHRYSOMYXA.

MELANTHERA ASPERA (Jacq.) Steud., HASTATA Michx.: *Uromyces columbianus*.

MELANTHERA NIVEA (L.) Small: *Puccinia melantherae*, *Uromyces columbianus*.

MELOTHRIA GUADALUPENSIS (Spreng.) Cogn., SCABRA Naud.: *Uromyces hellerianus*.

METASTELMA PEDUNCULARE Decne.: Puccinia obliqua.
MICROMERIA BROWNEI Benth.: Puccinia menthae.
MICROPUCCINIA see PUCCINIA.
MIKANIA CORDIFOLIA (L.f.) Willd.: Endophylloides portoricensis, Puccinia spegazzinii.
MIKANIA MICRANTHA H.B.K., SCANDENS Willd.: Endophylloides portoricensis.
MIMOSA ALBIDA H. & B.: Ravenelia mainsiana, R. mimosae-albidae.
MIMOSACEAE (undet.): Ravenelia distans.
MONTANOA HIBISCIFOLIA (Benth.) Sch. Bip., PITTIERI Rob. & Greenm., PTEROPODA Blake: Uromyces montanoae.
MORUS INSIGNIS Bur. ? : Cerotelium fici.
MUCUNA ANDREANA Micheli: Uromyces illotus.
MUEHLENBECKIA TAMNIFOLIA (H.B.K.) Meissn.: Uredo muehlenbeckiae.
MUHLENBERGIA CILIATA (H.B.K.) Kunth, QUITENSIS (H.B.K.) Hitch.: Puccinia dochmia.
NEOBRITTONIA ACERIFOLIA (Lag.) Hochr.: Puccinia heterospora.
NEONELSONIA OVATA C. & R.: Puccinia obscurata.
NEPHLYCTIS see PROSPODIUM.
NEUROLAENA LOBATA (L.) R. Br.: Puccinia emiliae.
NIGREDO see UROMYCES.
NISSOLIA FRUTICOSA Jacq.: Uropyxis nissoliae.
NOCCA see LAGASCEA.
NOTOPTERA BREVIPES see OTOPAPPUS.
OLYRA LATIFOLIA L.: Puccinia deformata.
ONCIDIUM CAVENDISHIANUM Batem.: Uredo behnickiana, U. oncidii.
OSTRYA VIRGINIANA var. GUATEMALENSIS (Winkl.) Macbr.: Melampsoridium carpini.
OTOPAPPUS CURVIFLORUS (R. Br.) Hemsl.: Puccinia cornuta, P. oblata.
OXALIS DIVERGENS Benth., LATIFOLIA H.B.K.: Puccinia oxalidis.
PADUS see PRUNUS.
PANICUM ARUNDINARIAE Trin.: Angiopsora lenticularis.
PANICUM BARBINODE Trin.: Uromyces leptodermus.
PANICUM FASCICULATUM Sw.: Puccinia circumdata.
PANICUM MAXIMUM Jacq.: Uromyces leptodermus.
PAROSELA DIFFUSA (Moric) Rose, DOMINGENSIS (DC.) Millsp., NUTANS (Cav.) Rose: Uropyxis daleae.
PASPALUM AFFINE Steud.: Puccinia substriata.
PASPALUM CANDIDUM (H. & B.) Kunth: Puccinia macra.
PASPALUM CONJUGATUM Berg: Angiopsora compressa.
PASPALUM FASCICULATUM Willd.: Angiopsora compressa.
PASPALUM HUMBOLDTIANUM Fluegge: Angiopsora compressa. Puccinia levis.
PASPALUM LANGEI (Fourn.) Nash: Puccinia substriata.
PASPALUM PANICULATUM L.: Puccinia dolosa, P. substriata.
PASPALUM SQUAMULATUM Fourn.: Angiopsora compressa.
PAVONIA ROSEA Schl.: Puccinia exilis.
PAVONIA SPICATA Cav.: Puccinia heterospora.
PERIDERMIUM GUATEMALENSE Arth. & Kern, on Pinus montezumae (P. filifolia), Sacatepéquez: K 4626 (type), 5324, 5355.
All Guatemalan collections are from Antigua. The species has

been recorded also for Mexico and Florida.

PERIDERMIUM MONTEZUMAE Cumm., on Pinus montezumae, Alta Verapaz: Cook; Chimaltenango: J (type). For a description and comparison with P. guatemalense see Cummins (15). Known only from the above collections.

PERNETTIA CILIATA (C. & S.) Small: Pucciniastrum myrtilli.

PERSICARIA see POLYGONUM.

PERYMENIUM GRANDE Hemsl., PURPUSII Brand., STRIGILLOSUM (Rob. & Greenm.) Greenm.: Uromyces cucullatus.

PHAKOPSORA AESCHYNOMENES Arth., on Aeschynomene sp., Chimaltenango: J 178. The telial stage is not known. Not previously recorded for Guatemala. Known also from British Honduras, Mexico, the West Indies, and South America.

PHAKOPSORA CHERIMOLIAE (Lagerh.) Cumm., on Annona cherimolia, Guatemala: K 5463; Huehuetenango: J 1916. Not previously recorded for Guatemala. Telia, present in the Kellerman collection, were recently described by Cummins (18). Known from Florida southward into South America.

PHAKOPSORA JATROPHICOLA (Arth.) Cumm., on Jatropha curcas, Izabal: K 7582; Jutiapa: S 75916; Retalhuleu: S 88601; Santa Rosa: S 79092, 79720; Zacapa: K 7831. Telia were described by Cummins (10) on J. canescens from Lower California. Telia have also been collected in Brazil.

PHAKOPSORA MEIBOMIAE Arth., on Desmodium intortum, Quezaltenango: S 67228; Sacatepequez: S 64683; on D. sp., Chimaltenango: J 163; Sacatepéquez: S 60293. Not previously recorded for Guatemala. Reported also for the West Indies, South America, and the Philippines.

PHAKOPSORA TECTA Jacks. & Holw., on Commelina elegans, Sacatepéquez: S 58631. Not previously recorded for Guatemala. A description, accompanied by illustrations, was published by Jackson (25). Reported previously as Uredo commelyneae. Widely distributed in the tropics.

PHAKOPSORA VIGNAE (Bres.) Arth., on Canavalia villosa, Huehuetenango: S 83032; Sacatepéquez: S 81016; on Phaseolus macrolepis, Quezaltenango: S 83605, 86616; on Vigna repens, Guatemala: S 61458. A description of the telial stage, as represented on Canavalia villosa, was published by Cummins (20). Widely distributed in the tropics.

PHAKOPSORA VITIS (Thüm.) Syd., on Vitis tiliaefolia, Guatemala: H 680, J 85, S 82917; on V. vinifera, Chimaltenango: S 80806. Common in warmer regions.

PHARBITIS see IPOMOEA.

PHASEOLUS ATROPURPUREUS Moc. & Sessé, LUNATUS L.: Uromyces phaseoli.

PHASEOLUS MACROLEPIS Piper: Phakopsora vignae, Uromyces phaseoli.

PHASEOLUS VULGARIS L.: Uromyces phaseoli.

PHRAGMIDIUM DISCIFLORUM (Tode) James, on Rosa sp., Huehuetenango: H 778; Sacatepéquez: H 544; Totonicapán: S 84063; Solola: J 86, Widely distributed on cultivated roses.

PHRAGMIDIUM GUATEMALENSE Cumm., on Potentilla heterosepala, Chimaltenango: J 650, S 61006; Sacatepéquez: H 572 (type), 657, J 341, S 65111. Known only from Guatemala. For a description see Cummins (15). The Holway collections were reported by Arthur (2) as P. potentillae.
PHRAGMIDIUM OCCIDENTALE Arth., on Rubus trilobus; Chimaltenango: S 61790; Huehuetenango: S 81734, 81790; Quezaltenango: H 813, S 84258. Occurs northward to Alaska.
PHRAGMOPYXIS DEGLUBENS (B. & C.) Diet., on Benthamantha cinerea, Guatemala: H 607; on B. mollis, Chimaltenango: J 1463. Known otherwise from Arizona, Mexico, and Ecuador.
PHYLLANTHUS CONAMI Sw.: Aecidium albicans, Ravenelia appendiculata.
PILEOLARIA STANDLEYI Cumm., on Pistacia mexicana, Baja Verapaz: S 91090 (type). P. standleyi is the only rust known to occur on Pistacia in the Americas and is known only from the type. For a description and illustrations see Cummins (20).
PINUS MONTEZUMAE Lamb.: Cronartium quercuum, Peridermium guatemalense, P. montezumae.
PINUS OOCARPA Schiede: Cronartium quercuum.
PINUS sp.: Cronartium coleosporioides, C. quercuum.
PIPTOCARPHA CHONTALENSIS Baker: Puccinia scorsa.
PIQUIERIA STANDLEYI Rob.: Puccinia conoclinii.
PISTACIA MEXICANA H.B.K.: Pileolaria standleyi.
PITHECOCTENIUM ECHINATUM (Jacq.) K. Schum.: Prospodium depallens.
PLUCHEA ODORATA (L.) Cass.: Puccinia plucheae.
PLUMIERA ACUTIFOLIA Poir., LUTEA Ruiz & Pav., RUBRA L.: Coleosporium plumierae Pat.
POA ANNUA L.: Puccinia poae-sudeticae.
POINCIANA see CAESALPINIA.
POLYGALA AMERICANA Mill.: Uredo peribebuyensis.
POLYGONUM MEISNERIANUM C. & S., PUNCTATUM Ell.: Puccinia polygoni-amphibii.
POLYMNIA MACULATA Cav.: Uromyces polymniae.
POLYPODIUM PLESIOSORUM Kunze: Uredinopsis sp.
POROPHYLLUM RUDERALE (Jacq.) Cass.: Puccinia porophylli.
POTENTILLA HETEROSEPALA Fritsch: Phragmidium guatemalense.
PRIONOSCIADIUM CUNEATUM C. & R., THAPSOIDES (DC.) Mathias: Puccinia prionosciadii.
PROSPODIUM APPENDICULATUM (Wint.) Arth., on Tecoma mollis, Sacatepéquez: H 75, K 7449; on T. stans, Chimaltenango: J 1461: Guatemala: H 469, 639a, 207; Huehuetenango: S 83038; Jalapa: K 7919, S 77143; Jutiapa: S 75213; Sacatepéquez: S 81005. For descriptions, discussion and illustrations of this and the following species see Cummins' (13) recent monographic study of the genus Prospodium.
PROSPODIUM CONJUNCTUM (Diet. & Holw.) Cumm., on Lippia myriocephala, Quezaltenango: S 84636. Not previously recorded for Guatemala. Otherwise known from two Mexican collections on L. pringlei. The species is microcyclic.
PROSPODIUM CYDISTAE Mains, on Cydista sp.; El Petén, Lundell 1681.

Mains (36) published photographic illustrations when he described the species. Known only from the above collection.

PROSPODIUM DEPALLENS (Arth. & Holw.) Cumm., on Pithecoctenium echinatum, Guatemala: H 492. Otherwise known only from the type collection made in Costa Rica. The species is microcyclic.

PROSPODIUM ELATIPES (Arth. & Holw.) Cumm., on Lippia myriocephala, Quezaltenango: H 831 (type); Solola: H 678. Otherwise known from one collection each in British Honduras and Costa Rica. The species is closely related to P. depallens.

PROSPODIUM LIPPIAE (Speg.) Arth., on Lippia asperifolia, Guatemala: H 617; on L. dulcis, El Petén; on L. myriocephala, Guatemala: K 5451; on L. strigosa, Chimaltenango: J 358, 611; Quezaltenango: H 730, 787; Solola: H 152; on L. umbellata, Sacatepéquez: H 554; on L. sp., Chimaltenango: H 667.

PROSPODIUM TRANSFORMANS (E. & E.) Cumm., on Tecoma stans, Guatemala: H 467, 639, S 92868. The species is microcyclic.

PROSPODIUM TUBERCULATUM (Speg.) Arth., on Lantana camara, Chimaltenango: J 745; Sacatepéquez: S 63866; on L. hispida, Quezaltenango: S 83801; on L. sp., Huehuetenango: H 767.

PRUNUS CAPULI Cav., PERSICA (L.) Sieo. & Zucc., SEROTINA Ehrb.: Tranzschelia pruni-spinosae.

PSEUDABUTILON SPICATUM (H.B.K.) Fr.: Puccinia heterospora.

PSEUDELEPHANTOPUS SPICATUS (Juss.) Rohr.: Puccinia paupercula.

PSITTACANTHUS CALYCULATUS (DC.) G. Don: Aecidium loranthi.

PTERIDIUM AQUILINUM (L.) Kühn: Uredinopsis macrosperma.

PUCCINIA ABRUPTA Diet. & Holw., on Verbesina perymenioides, Guatemala: H 6, 200; On V. punctata, Jalapa: S 76702; on V. sp., Guatemala: K 5455. Occurs from the southern United States southward into South America.

PUCCINIA ACNISTI Arth., on Acnistus arborescens, Jalapa: K 7686, S 76367, 77389. Uredia are not formed by this rust. The species has not been recorded previously for Guatemala although Kellerman's collection was made in 1908. Known also from Costa Rica and South America.

PUCCINIA AEGOPOGONIS Arth. & Holw., on Aegopogon cenchroides, Chimaltenango: S 79807; Guatemala: H 54, 869; Huehuetenango: H 760; Quezaltenango: K 5572, 5932, 5948; Sacatepéquez: H 650; Solola: H 164; on A. tenellus, Guatemala: H 37; on Eupatorium ligustrinum, Alta Verapaz: S 70422; on E. mairetianum, Chimaltenango: J 1933; Huehuetenango: S 82431, 82930; Jalapa: S 77249; Quezaltenango: S 83231; Solola: H 113; on E. rafaelense, Chimaltenango: J 355, 1433, S 57880, 61557, 64373; Huehuetenango: S 65745; Sacatepéquez: J 859, S 63856; on E. sp., Guatemala: H 631, 868; Huehuetenango: H 754. Holway concluded, from field observations, that the aecia on Eupatorium and the telia on Aegopogon were alternate stages of a single species. The aecia are not distinguishable from those of Uromyces aegopogonis, whose telial stage has not been found in Guatemala. P. aegopogonis is known to occur also in Bolivia and Ecuador.

PUCCINIA ALIA Jacks. & Holw., on Baccharis trinervis, Jalapa: S 77526. Otherwise known from Brazil where it occurs on the same host. Telia are not present in the above specimen. For a description see Jackson (30).

PUCCINIA AMPHICSPORA (Jacks. & Holw.) Cumm., on Hyptis mutabilis, Chimaltenango: S 79744; Quezaltenango: S 87118; Retalhuleu: S 87753; Sacatepéquez: S 63851. Described and otherwise known only from Bolivia. This rust differs from P. hyptidis-mutabilis mainly in producing amphispores in addition to ordinary urediospores. For a description of the uredia see Jackson (30); for the telia see Cummins (12).

PUCCINIA ANCIZARI see P. INTERJECTA.

PUCCINIA ANDROPOGONIS Schw., on Andropogon condensatus, Solola: H 178. The aecial stage has not been collected in Guatemala but may occur on Castilleja or Lamourouxia, which are hosts of the correlated microcylic P. nesodes. Castilleja spp. are known aecial hosts in the United States.

PUCCINIA ANGUSTATA Peck var. ANGUSTATOIDES (Stone) Arth., on Rynchospora polyphylla, Alta Verapaz: S 92665. This variety is often treated as a distinct species, P. angustatoides, but was reduced in rank by Arthur (6). The aecial stage is not known. Known from the southern United States southward into South America.

PUCCINIA ANODAE Syd., on Anoda cristata, Chimaltenango: S 79897; Guatemala: S 89451; Huehuetenango: S 82392; Jalapa: S 76639; on A. hastata, El Petén: Heyde & Lux (type). The species is microcyclic. Reported also from Costa Rica, Mexico, and South America.

PUCCINIA ANTIRRHINI Diet. & Holw., on Antirrhinum majus, Chimaltenango: J. Not previously recorded for Guatemala but becoming generally distributed where snapdragons are grown.

PUCCINIA ARECHAVALETAE Speg., on Cardiospermum coluteoides, Dept. uncertain: H 208; on C. corindum, Guatemala: J 1138; Jalapa: K 7338; on C. grandiflorum, Guatemala: S 61346; Jalapa: K 5461, S 77525; on Serjania atrolineata, Izabal: S 72501; on S. caracasana, Izabal: S 23868; on S. racemosa, Santa Rosa: S 78001; on S. sp., Izabal: K 5306: Santa Rosa: S 78874; on Urvillea ulmacea, Escuintla: S 89480. This microcyclic species is common in the tropics.

PUCCINIA ARENARIICOLA see P. MODICA.

PUCCINIA ARRACACHAE Lagerh. & Lindr., on Arracacia bracteata, Sacatepéquez: H 86, 558; Quezaltenango: S 84248; on A. rigida, Sacatepéquez: K 7232, S 65153. Recorded otherwise only for Ecuador. This rust was first reported for Guatemala by Arthur (3) but under the non-valid name, P. arracacharum.

PUCCINIA ASTERIS Duby, on Aster bullatus, Alta Verapaz: S 90514; on Erigeron bonariensis, Guatemala: H 39; on E. deamii, Solola: H 112; on E. karvinskyanus, Guatemala: H 686; Sacatepéquez: S 81004; on E. spathulatus, Quezaltenango: S 83426, 83915, 86040; on E. sp., Huehuetenango: H 776. This species is microcyclic and common, especially northward.

PUCCINIA ATRA Diet. & Holw., on *Valota insularis*, Guatemala: H 205, K 5469. This rust is also known to parasitize other closely related genera. The aecial stage is not known. For a discussion of this species and for illustrations from type specimens see Cummins (19).

PUCCINIA BACCHARIDIS Diet. & Holw., on *Baccharis glutinosa*, Guatemala: H 91; Huehuetenango: S 82265; Sacatepéquez: S 64720; Solola: H 158; on *B.* sp., Chimaltenango: J 684, 742, 878. For keys to the species of *Puccinia* on *Baccharis* see Jackson (30).

PUCCINIA BACCHARIDIS-MULTIFLORAE Diet. & Holw., on *Baccharis kellermani*, Solola: K 6307; on *B. serraefolia*, Chimaltenango: S 79809; Huehuetenango: H 770; Sacatepéquez: S 60311, 63853; Solola: H 115, 123; on *B.* sp., Guatemala: H 687; Quezaltenango: H 731. Apically thickened urediospores characterize this species. Described and otherwise known from Mexico.

PUCCINIA BARTHOLOMAEI Diet., on *Bouteloua filiformis*, Guatemala: H 206. The aecial stage, which is on Asclepiadaceae, has not been found in Guatemala but may well occur since it has been collected in El Salvador. Common northward.

PUCCINIA BASIPORULA Jacks. & Holw., on *Eupatorium mairetianum*, Quezaltenango: H 93 (type), 723, 808, 837, S 86096; Totonicapán: S 84012; on *E. phoenicolepis*, Totonicapán: S 84136; on *E. rafaelense*, Quezaltenango: K 5416, 5449; San Marcos: S 66252. Known only from Guatemala. The urediospores have pores near the hilum.

PUCCINIA BERBERIDIS-TRIFOLIAE Diet. & Holw., on *Berberis fascicularis*, Huehuetenango: J 1690, S 81819. Otherwise known only from the type collected near Mexico City. The species is microcyclic.

PUCCINIA BOMAREAE (Lagerh.) P. Henn. This species was recorded by Arthur (5) but there is no specimen in the Arthur Herbarium and the record is marked out with pencil in the laboratory copy of the N. Am. Flora. The rust was probably found to be *P. pallor*.

PUCCINIA CALEAE Arth., on *Calea zacatechichi*, Chimaltenango: J 685, 776, S 57935; Guatemala: H 7, 89; Quezaltenango: S 84892, 87073; Sacatepéquez: H 643, S 61689, 63352, 64630; Solola: H 132; on *C.* sp., Solola: H 675. Known from Mexico and Central and South America.

PUCCINIA CANALICULATA (Schw.) Lagerh., on *Cyperus meyenianus*, Chimaltenango: S 79761; on *C.* sp., Izabal: H 593. The aecial stage occurs on *Ambrosia* and *Xanthium* but is unknown in the southern range of the species. Occurs in the United States and southward to northern South America.

PUCCINIA CANNAE (Wint.) P. Henn., on *Canna indica*, Escuintla: S 64024; Suchitepéquez: K 5357, 5386; Solola: J 68; on *C.* sp., Suchitepéquez: H 516. Known from Florida southward into South America.

PUCCINIA CARICIS-POLYSTACHYAE Diet., on *Carex polystachya*, Guatemala: H 55, 611; Huehuetenango: S 81520; Jalapa: S 76488; Sacatepéquez: K 7197 (type of *P. kellermanii* Kern); Solola:

H 124. Presumably this species is heteroecious but the aecial stage is unknown. Known otherwise from Mexico.

PUCCINIA CENCHRI Diet. & Holw., on Cenchrus echinatus, Guatemala: H 591; on C. pilosus, Zacapa: S 74593; on C. viridis, Izabal: H 597. The aecial stage is unknown. Occurs from the United States southward into South America.

PUCCINIA CHASEANA Arth. & Fromme, on Anthephora hermaphrodita, Izabal: H. 600. This species appears not to have been collected elsewhere in continental North America. Reported also from the West Indies and Colombia. The aecial stage is unknown.

PUCCINIA CIRCINATA (Schw.) Arth., on Stigmaphyllon sp., Guatemala: K 5397; Zacapa: K 5457. The host was determined by Greenman as near S. tomentosum. The rust was first described from Surinam and appears not to have been reported for other countries.

PUCCINIA CIRCUMDATA Mains, on Panicum fasciculatum, Zacapa: S 74571. The aecial stage is unknown and to date the only known grass host is P. fasciculatum. For a description see Mains (36), for further discussion and an illustration from the type collection see Cummins (19).

PUCCINIA CIRSII Lasch, on Cirsium mexicanum, Guatemala: S 58483; Sacatepéquez: S 63645, 64733; on C. subcoriaceum, Chimaltenango: S 80244; on C. sp., Huehuetenango: J 1925. Widely distributed.

PUCCINIA CLADII Ellis & Tr., on Rynchospora robusta, Alta Verapaz: S 92800. This rust occurs northward to the United States. The aecial stage is unknown.

PUCCINIA COGNATA Syd., on Verbesina fraseri, Guatemala: H 464, 604, K 4324, 5369, 5412; Sacatepéquez: H 73, S 63041, 81015; on V. holwayi, Quezaltenango: H 96B, 738; on V. punctata, Sacatepéquez: S 63865; on V. sublobata, Quezaltenango: S 84310a; Solola: H 175a, 180; on V. turbacensis, Quezaltenango: S 83189, 83927, 85774; on V. sp., Chimaltenango: J 256; Guatemala: K; Suchitepéquez: H 523; Solola: H 135, 177, K 6306. Reported from the southern United States to Venezuela.

PUCCINIA COMMELINAE Holw., on Commelina elegans, Chimaltenango: J 851; Jutiapa: S 74905; Retalhuleu: S 88762; Sacatepéquez: J 60. Otherwise known to occur in Mexico and perhaps Grenada. Phakopsora tecta occurs on the same host in Guatemala.

PUCCINIA CONOCLINII Seym., on Ageratum conyzoides, Alta Verapaz: S 90150; Retalhuleu: H 697, K 5446; Suchitepéquez: K 4346, 5373; on A. corymbosum var. latifolium, Guatemala: H 482, 623; Sacatepéquez: S 64276; on A. rugosum, Sacatepéquez: H 74; on A tomentosum, Chimaltenango: J 1442; S 79849; Sacatepéquez: S 61755; on Eupatorium collinum, Guatemala: H 627, K 5318; Huehuetenango: H 757; on E. glandulosum, Quezaltenango: H 810; on E. neaeanum, Solola; H 131; on E. oresbioides, San Marcos: S 66315; on E. pycnocephaloides. Huehuetenango: H 774; Quezaltenango: H 750, S 84325; Sacatepéquez: H 83, 564; Solola: H 144; Totonicapán: H. 106; on E. pycnocephalum, Guatemala: K 5312, 5350, 5354; Retalhuleu: H 713; Quezaltenango: S 83783, 85029; Sacatepéquez: H 549,

S 64283; Solola: H 153; on E. sp., Chimaltenango: S 80021; Guatemala: H 629, K 6297; Quezaltenango: H 801; Retalhuleu: H 717; on Piqueria standleyi, Jutiapa: S 75496. This is a common species. The specimen on Piqueria was reported with an illustration by Cummins (20), and is the only record for this genus.

PUCCINIA CORDIAE (P. Henn.) Arth., on Cordia alliodora, Escuintla: H 503, 508: Santa Rosa: S 77706. Known also from Costa Rica, Puerto Rico, and South America. For recent notes on this species see Mains' (41) discussion following the description of P. ciliata.

PUCCINIA CORNUTA Jacks. & Holw., on Otopappus curviflorus, Guatemala: H 846 (type), 493; Sacatepéquez: S 64634. The host of the Holway collections was originally reported as Notoptera brevipes but was examined in 1940 by Standley, who identified it as O. curviflorus. Except for an aecial collection from British Honduras the species is known only from Guatemala. Uredia are not formed.

PUCCINIA CORONATA Corda, on Avena sativa, Chimaltenango: J 1701, S 79742, 79747. Common where oats are grown.

PUCCINIA CRASSIPES B. & C., on Ipomoea glabriuscula, Guatemala: H 472; Santa Rosa H 856; on I. tiliacea, Guatemala: H 11, 201; on I. trifida, Guatemala: K 5396, 5407; Jutiapa: S 75043; Quezaltenango: S 84783, 87099; Retalhuleu: S 88609; on I. triloba, Jutiapa: S 75882; on I. sp., Guatemala: K 5356, 5406; Quezaltenango: S 67958. Uredia are not formed. Occurs from the southern United States southward to Argentina.

PUCCINIA CUILAPENSIS Cumm., on Salvia gracilis, Quezaltenango: S 85744, 85830; on S. mocinoi, Santa Rosa: S 78545 (type); on S. sp., Santa Rosa: S 78008. This species is known only from the above collections. For a description and illustration see Cummins (20).

PUCCINIA CUPHEAE Holw., on Cuphea aequipetala, Chimaltenango: S 60020; Sacatepéquez: J 392; on C. appendiculata, Alta Verapaz: S 69355; Quezaltenango: S 84851; on C. axilliflora, Alta Verapaz: S 92749. The species is microcyclic. See also P. jaliscensis which has been reinstated as a valid species.

PUCCINIA CYANI (Schleich.) Pass., on Centaurea cyanus, Chimaltenango: J 1907; S 83893. Not previously reported for Guatemala. Widely distributed.

PUCCINIA CYNODONTIS Lacroix, on Cynodon dactylon, Chimaltenango: J 1698; Guatemala: H 592, 305; Izabal: H 599. The aecial stage is unknown. Widely distributed in the warmer regions of the world.

PUCCINIA CYPERI Arth., on Cyperus ferax, Chimaltenango: J 845; on C. hermaphroditus, Chimaltenango: J, S 80226; Guatemala: H 136A; on C. incompletus, Sacatepéquez: J 62, 63; on Kyllinga pumila, Alta Verapaz: S 70131; on K. odorata, Solola: H 663. Telia have not been collected on Kyllinga and the rust on that genus is sometimes kept separate as Uredo kyllingae. The aecial stage (Aecidium erigerontis Kern & Whetzel) of the

Cyperus rust occurs on Erigeron but is not known from Guatemala. The walls of the aeciospores are thickened apically. Occurs from the United States into South America.

PUCCINIA DEFORMATA B. & C., on Olyra latifolia, El Petén: Lundell 3610. First reported for Guatemala by Mains (36). Known also from Nicaragua, the West Indies, and South America.

PUCCINIA DEGENER Mains & Holw., on Salvia albiflora, Quezaltenango: H 838 (type); on S. myriantha, Quezaltenango: S 83614, 85954; on S. sp., San Marcos: S 66185. The species was originally described from the uredial stage. For a description of the other spore-forms and a photograph of a teliospore see Cummins (20). Known only from the above collections.

PUCCINIA DELICATULA (Arth.) Sacc. & Trott., on Salvia cinnabarina, Chimaltenango: J 239, S 79960; Huehuetenango: H 769; Quezaltenango: H 751, 811, S 83964; El Quiché: J 1448; San Marcos: S 85364; on S. elegans, Solola: H 140; on S. holwayi, Quezaltenango: H 743, 789, on S. pulchella, Guatemala: H 41. Otherwise known from Mexico. P. niveoides is a closely related species. Both are microcyclic.

PUCCINIA DEPALLENS see PROSPODIUM DEPALLENS.

PUCCINIA DETONSA Arth. & Holw., on Stellaria ovata, Quezaltenango: H 824. Known otherwise from Costa Rica on the same host. The species is microcyclic.

PUCCINIA DICHONDRAE Mont., on Dichondra sericea, Guatemala: H 50. This species is microcyclic. Widely distributed.

PUCCINIA DICHROMENAE (Arth.) Jacks., on Dichromena ciliata, Alta Verapaz: S 90045, 92238; on D. radicans, Alta Verapaz: S 69176, 70128. The aecial stage is unknown. Known from Central and South America and the West Indies.

PUCCINIA DISCRETA Jacks. & Holw., on Vernonia deppeana, Baja Verapaz: K 7026; Chimaltenango: J 348; Quezaltenango: H 818; Retalhuleu: H 721. Known also from Costa Rica and Peru. The species is microcyclic.

PUCCINIA DOCHMIA B. & C., on Muhlenbergia ciliata, Guatemala: H 53; on M. quitensis, Sacatepéquez: K 7196, 7199. The aecial stage is unknown. Known also from Costa Rica and Nicaragua.

PUCCINIA DOLOSA Arth. & Fromme, on Paspalum paniculatum, Retalhuleu: S 87244; on P. sp., Chimaltenango: J 1696. Not previously reported for Guatemala. The species was long treated as a synonym of P. substriata. No aecial stage is known. For a description, discussion and illustration see Cummins (19).

PUCCINIA DYSCHORISTES Cumm., on Dyschoriste quadrangularis, Jutiapa: S 76263 (type). Known only from the above collection. For a description and illustration see Cummins (20).

PUCCINIA ELATIPES see PROSPODIUM ELATIPES.

PUCCINIA ELECTRAE Diet. & Holw. on Coreopsis mutica, Guatemala: H 5, 52 (type of P. coreopsidis Jacks. & Holw.), 613; Quezaltenango: H 725B, S 83209, 83962; Sacatepéquez: S 58898a, 61688, 80976; Solola: H 154. Known otherwise from Mexico.

PUCCINIA ELYTRARIAE P. Henn., on Elytraria imbricata, Santa Rosa: S 78024; on E. sp., Guatemala: H 635. The species is microcyclic. Known from Mexico into South America and reported from Japan.

PUCCINIA EMILIAE P. Henn., on Neurolaena lobata, Izabal; K 6316. This collection was reported by Davidson (21). The species is microcyclic. Known from Florida southward to South America.

PUCCINIA ENGELIAE Diet. & Holw., on Simsia foetida, Chimaltenango: J 359; Sacatepéquez: S 63042, 64732; on S. holwayi, Santa Rosa: H 854; on S. lagascaeformis, Sacatepéquez: J 384, 387; on S. polycephala, Guatemala: H 624; Jutiapa: S 75053, 77571; on S. sericea, Guatemala: H 63; Sacatepéquez: H 79, 548. Known from southern California to Chile.

PUCCINIA EPIPHYLLA see PUCCINIA POAE-SUDETICAE.

PUCCINIA ERRATICA Jacks. & Holw., on Vernonia schiedeana, Guatemala: H 480, 494, 621, 841. Known also from British Honduras and Mexico.

PUCCINIA EUPHORBIAE var. LONGIPES Syd., on Euphorbia caracasana, Chimaltenango: J 774; Guatemala: H 3; Quezaltenango: H 740; Sacatepéquez: H 66, 641, J 55; on E. cotinifolia, Chimaltenango: S 79976; Jalapa: S 76721; Quezaltenango: S 83921; Solola: K 5433; Dept. unknown: Rojas 42. Known otherwise from Mexico.

PUCCINIA EXILIS Syd., on Pavonia rosea, Izabal: H 593. Known also from South America. The species is microcyclic.

PUCCINIA EXIMIA Arth. & Holw., on Galium mexicanum, Escuintla: S 61316; Sacatepéquez: H 81, 542, K 7098, S 63750; on G. sp., Quezaltenango: H 735 (type), 809; Sacatepéquez: H 645. Known only from Guatemala.

PUCCINIA EXORNATA Arth., on Baccharis rhexioides, Chimaltenango: J 842; Guatemala: H 462, 863, K 5470; Sacatepéquez: J 66; Solola: H 174; on B. thesioides, Guatemala: K 5368 (type); on B. trinervis, Alta Verapaz: S 69531; Sacatepéquez: S 59827, 60340. For keys to the species of Puccinia on Baccharis see Jackson (30). Known from Mexico, Central America, and Brazil.

PUCCINIA FARINACEA Long, on Salvia amarissima, Sacatepéquez: H 547; on S. elegans, Quezaltenango: H 780; Solola: H 140a; on S. holwayi, Quezaltenango: H 741, S 83198, 83951, 85262; Totonicapán: S 83973, 84131; on S. kellermani, Quezaltenango: S 87091; on S. lavanduloides, Chimaltenango: S 79726: Sacatepéquez: H 654; Solola: H 165; Totonicapán: S 84138; on S. lindenii, Quezaltenango: H 833; Sacatepéquez: H 88, 580; on S. nepetoides, Quezaltenango: H 94; on S. patens, Quezaltenango: J 1761; on S. riparia, Chimaltenango: S 79739; on S. sp., Guatemala: K 5471, 5472; Huehuetenango: H 773, 777; Quezaltenango: J 521. Occurs northward to Nebraska.

PUCCINIA FEROX Diet. & Holw., on Verbesina punctata, Quezaltenango: S 68099 bis; on V. turbacensis, Alta Verapaz: S 69056. Not previously recorded for Guatemala. Known also from Costa Rica, Mexico, and South America. The species is microcyclic.

PUCCINIA FIDELIS Arth., on Hyptis lilacina, Guatemala: H 27a, K 5334; on H. oblongifolia, Santa Rosa: S 77956; on H. pectinata,

Chimaltenango: S 79864, 80215; Quezaltenango: S 83913; Solola: H 136; on H. urticoides, Chimaltenango: J 160; Guatemala: K 5380, 5401; Sacatepéquez: S 63864, 64938. Known otherwise from Mexico.

PUCCINIA FILICLA Mains & Holw., on Salvia involucrata, Solola: H 156 (type); on S. nervata, Huehuetenango: J 1931; Quezaltenango: S 85306; on S. pulchella, Guatemala: H 19a, 41a; Totonicapán: H 107; on S. sp., Quezaltenango: S 66326; Sacatepéquez: H 579. Recorded for Guatemala and South America, the latter an uredial collection.

PUCCINIA FILOPES Arth. & Holw. on Buettneria lateralis, Escuintla: H 501 (type). Known also from Costa Rica, Panama, and Colombia. The species is microcyclic.

PUCCINIA FLAVO-VIRENS Jacks. & Holw., on Cyperus ferax, Chimaltenango: S 79826; on C. sp., Sacatepéquez: S 60297. First reported for North America by Cummins (15), based on Standley 60297. Otherwise known from Ecuador and Mexico. For a description see Jackson (25).

PUCCINIA FUCHSIAE Syd. & Holw., on Fuchsia chiapensis, San Marcos: S 66286; on F. microphylla, Quezaltenango: H 753; on Lopezia hirsuta, Chimaltenango: J 53; Guatemala: H 34; Sacatepéquez: H 647. The species is microcyclic. Known from Mexico to Panama.

PUCCINIA FUIRENAE Cooke, on Fuirena incompleta, Huehuetenango: S 82958. This record was published by Cummins (20).

PUCCINIA FUMOSA Holw., on Loeselia ciliata, Guatemala: H 636; Jutiapa: S 76303; on L. glandulosa, Chimaltenango: J, S 79782, 79859; Jalapa: S 77539; Quezaltenango: S 83881; Sacatepéquez: K 5464, S 60896; Solola: H 184. Known also from Costa Rica, El Salvador, and Mexico.

PUCCINIA FUSCATA Arth. & Holw., on Cunila leucantha, Quezaltenango: H 742, 785 (type); on C. polyantha, Quezaltenango: S 83779; Solola: H 166. Known only from Guatemala.

PUCCINIA GILVA Arth. & Holw., on Heliotropium physocalycinum, Guatemala: H 626; Sacatepéquez: H 658 (type), S 64278; on H. rufipilum, Jutiapa: S 78485. Known only from Guatemala.

PUCCINIA GNAPHALII (Speg.) P. Henn., on Gnaphalium rhodanthum, Sacatepéquez: H 578. Occurs from the southern United States into South America.

PUCCINIA GOUANIAE Holw., on Gouania lupuloides, Escuintla: H 500; Retalhuleu: S 88387; on G. polygama, Jutiapa: S 78472; Retalhuleu: S 88354; Santa Rosa: S 77847, 79409. Known from Central and South America and the West Indies.

PUCCINIA GRAMINIS Pers., on Triticum aestivum, Chimaltenango: J. Not previously reported for Guatemala but probably common as it is elsewhere throughout the world.

PUCCINIA GYMNOLOMIAE Arth., on Hymenostephium cordatum, Quezaltenango: H 828; Retalhuleu: H 692; on H. microcephalum, Guatemala: H 861; Sacatepéquez: H 556; J 71; on H. sp., Sacatepéquez: H 652. Johnston's collection is an Aecidium, which probably represents the aecial stage of this species. The aecia occur

in rather loose groups on discolored spots; the spores measure 15-18 x 18-22 µ and have a hyaline, finely verrucose wall 1 µ in thickness. Known also from Costa Rica and Mexico.

PUCCINIA HACKELIAE Cumm., on Hackelia mexicana, Dept. uncertain: J (type). Known only from the type. For a description see Cummins (15).

PUCCINIA HELIANTHI Schw., on Helianthus annuus, Chimaltenango: S 74831. Not previously reported from Guatemala. Widely distributed.

PUCCINIA HELICONIAE (Diet.) Arth., on Heliconia sp., Dept. unknown: K; Retalhuleu: S 88740; Santa Rosa: S 60666. The species has also been intercepted in Customs inspection. Not previously recorded for Guatemala. Known from Central and South America and the West Indies.

PUCCINIA HELIOTROPII Kern & Kellerm., on Heliotropium indicum, Guatemala: H 468; Zacapa: K 4326 (type), 5422, 5426. Long known only from Guatemala but recently recorded for British Honduras, Colombia, and Venezuela. The species is microcyclic.

PUCCINIA HENRYAE Cumm., on Henrya imbricans, Guatemala: K 5390 (type). Known only from the type. For a description and illustration see Cummins (18).

PUCCINIA HETEROSPORA B. & C., on Abutilon giganteum, Chimaltenango: S 79772, 79992; Sacatepéquez: J 911; on A. sp., Sacatepéquez: J 852, 866; Quezaltenango: H 797, 798; on Anoda cristata, Chimaltenango: J 54, 326; Jutiapa: S 75944; Sacatepéquez: S 58052, 60877; Santa Rosa: S 78653; on Gaya calyptrata, Jutiapa: S 74995, 75776, 76051; on Malva sylvestris, Chimaltenango: S 79882; on Malvaviscus arboreus, Chimaltenango: S 80251; Retalhuleu: H 694; Suchitepéquez: H 529; on M. sp., Guatemala: H 485; on Neobrittonia acerifolia (Abutilon discissum), Chimaltenango: J 1685; Quezaltenango: H 782, S 83311; on Pavonia spicata, Izabal: S 72158; on Pseudabutilon spicatum, Santa Rosa: S 79140, 79252, 79692; on Sida ciliaris, Jutiapa: S 75039; on S. cordifolia, Guatemala: H 474; Jalapa: K 7056; Zacapa: K 4323; on S. sp., Zacapa: K 5421; on Wissadula amplissima, Jutiapa: S 74841; on W. periplocifolia, Jutiapa: S 75962. A widely distributed microcyclic species.

PUCCINIA HIASCENS Arth., on Clethra lanata, Chimaltenango: J 1462; on Saurauia conzattii, Guatemala: H 90, 608; on S. costaricensis, Retalhuleu: S 87198; on S. pauciserrata, Huehuetenango: H 775; on S. smithiana, Quezaltenango: H 819, 830 (type); on S. sp., Guatemala: H 844. The status of the above collections is most uncertain. Holway's collections were mainly identified by Buscalioni in 1917 as on various species of Saurauia and his determinations were verified in part by Standley in 1935. However, Standley identified the host of Johnston's collection as Clethra lanata and commented on Holway's nos. 90, 608, and 844 as follows: "We have no Saurauia like them, and so far as I can see, they might just as well represent Clethra". The rust on all is alike and I am listing the collections as P. hiascens, although this may prove to be incorrect. The species is microcyclic. Known also from Mexico.

PUCCINIA HIERACII (Schum.) Mart., on Hieracium abscissum, Quezaltenango: S 83409; on H. sp., Sacatepéquez: H 577, 648. The species is widely distributed.

PUCCINIA HOGSONIANA Kern, on Eupatorium phoenicolepis Rob., Huehuetenango: S 81267; on E. phoenicolepis var. guatemalensis, Guatemala: K 5382, 5431, 5439, 6087 (type), El Quiché, J 1459; on E. schultzii var. erythranthodium, Santa Rosa: H 853; on E. schultzii var. ophryolepis, Quezaltenango: H 744, 804; Solola: H 187; on E. schultzii var. velutipes, Guatemala: H 587; Solola: H 170; on E. sp., Huehuetenango: J 1926, 1927; Solola: K 5414. Reported from Guatemala and Costa Rica. The pores in the urediospores are near the hilum.

PUCCINIA HYDROCOTYLES (Link) Cooke, on Hydrocotyle bonariensis, Solola: H 190; on H. mexicana, Alta Verapaz: S 69300, 70920; Baja Verapaz: S 90988; Quezaltenango: S 84276; Solola: H 189; on H. umbellata, Chimaltenango: S 79996; Guatemala: J 1431, K 5367, 5398, S 61331, 89460. Common in the uredial stage. Widely distributed.

PUCCINIA HYPTIDIS Tr. & Earle, on Hyptis pectinata, Guatemala: K Occurs from the southern United States southward into South America.

PUCCINIA HYPTIDIS-MUTABILIS Mayor, on Hyptis mutabilis, Chimaltenango: J. Puccinia amphiospora is a closely related species which forms amphispores. Known also from Florida, Costa Rica, and South America.

PUCCINIA IDONEA Jacks. & Holw., on Vernonia heydeana, Sacatepéquez: S 64934; on V. triflosculosa, Escuintla: H 498, 499 (type); Guatemala: H 481; Solola: H 670. Known otherwise from Costa Rica and El Salvador.

PUCCINIA IMPEDITA Mains & Holw., on Salvia hispanica, Huehuetenango: S 81197; on S. occidentalis, Retalhuleu: H 712; Sacatepéquez: H 642; Santa Rosa: S 78074; on S. tiliaefolia, Chimaltenango: S 79755; Jalapa: S 76494, 77419; Quezaltenango: S 83200, 83938, 84640; Sacatepéquez: S 61714, 64286. Known from Mexico, Central and South America, and the West Indies.

PUCCINIA INAEQUATA Jacks. & Holw., on Vernonia aschenborniana, Retalhuleu: S 87771; on V. patens, Baja Verapaz: K; Escuintla: H 502 (type); Guatemala: H 470; Huehuetenango: S 82823; Izabal: S 72426; Jalapa: K 5337; Retalhuleu: H 534; Santa Rosa: H 851, Heyde & Lux; Suchitepéquez: H 513. Known otherwise from Brazil and Ecuador.

PUCCINIA INAUDITA Jacks. & Holw., on Wedelia scapulcensis, Chimaltenango: J 1928, S 79966; on W. filipes, Jalapa: S 77531; on Zexmenia elegans, Retalhuleu: S 66727; on Z. leucactis, Escuintla: H 505; Quezaltenango: H 823; Retalhuleu: H 693 (type); on Z. longipes, Guatemala: H 628. Known otherwise only from Honduras.

PUCCINIA INCONDITA Arth., on Solanum salviifolium, Alta Verapaz: S 89755; on S. sp., Quezaltenango: S 65336. First reported for Guatemala by Cummins (15), based on Standley's no. 65336. Otherwise known only from Texas. For a recent review of the microcyclic species of Puccinia on Solanum see Kern (33).

PUCCINIA INFREQUENS Holw., on Salvia cinnabarina, Guatemala: H 19B, K 4623; Huehuetenango: H 768, S 81321; Quezaltenango: H 99, 727, 751a, S 83574, 84367; Sacatepéquez: H 78, 546, 552; Solola: K 5438; Totonicapán: S 84078; on S. urica, Chimaltenango: S 79779; Huehuetenango: S 81588; Quezaltenango: S 83575, 83949, 85247; Sacatepéquez: J 77, S 63710. Known otherwise from the type collected at Oaxaca, Mexico, on S. cinnabarina. For a description of the aecial stage see Cummins (15).

PUCCINIA INFUSCANS Arth. & Holw., on Andropogon saccharoides, Chimaltenango: J 1694; Guatemala: H 15 (type). This rust was originally described as on Imperata brasiliensis but the host was identified, together with that of Johnston's collection, as Andropogon saccharoides by Swallen in 1941. There is also a specimen in the Arthur Herbarium from Mexico on A. emersus.

PUCCINIA INSULANA (Arth.) Jacks., on Vernonia sp., Retalhuleu: H 537. Previously known from the West Indies but this appears to be the only record for continental America.

PUCCINIA INTERJECTA Jacks., on Baccharis heterophylla, Huehuetenango: S 82273, 82425; Totonicapán: S 84112; on B. lancifolia, Chimaltenango: H 660; Quezaltenango: H 103 (type); on B. vaccinioides, El Quiché: J 1460. In the North American Flora this rust was called P. ancizari. For the change of name and for keys to the species of Puccinia on Baccharis see Jackson (30). Known only from Guatemala.

PUCCINIA INVAGINATA Arth. & Johnst., on Gouania lupuloides, Escuintla: H 497; on G. sp., Guatemala: H 614, 618, K 6364; Suchitepéquez: H 518. Easily separable from P. gouaniae because of the reniform urediospores. Known also from the West Indies and South America.

PUCCINIA INVESTITA Schw., on Gnaphalium attenuatum, Chimaltenango: J 158, S 61530; on G. leptophyllum, Chimaltenango: J 173, 746; G. oxyphyllum, Quezaltenango: S 84184; on G. sp., Guatemala: H 610; Sacatepéquez: H 655. The species does not form uredia. Occurs from the southern United States into South America.

PUCCINIA IRREGULARIS Diet., on Verbesina steyermarkii, Santa Rosa: S 77954; on V. sp., Jalapa: K. First reported for Guatemala by Davidson (21) based on Kellerman's collection. Apparently an infrequent species, otherwise known from Nicaragua and South America.

PUCCINIA JALISCENSIS Holw., on Cuphea hookeriana, Chimaltenango: J 844, 1924; Sacatepéquez: J 880; Solola: H 133. This microcyclic species was given as a synonym of P. cupheae by Arthur (5) but appears to be quite distinct. The sori are small, separate and more or less aecidioid in appearance and the spores are larger, usually tapered apically and less deeply pigmented than is true of P. cupheae. Holway (24) published photographs of both species. Described and otherwise known from Mexico.

PUCCINIA KUHNIAE Schw., on Brickellia scoparia, Huehuetenango: J 1761. This is the first collection for Guatemala. Known also from the United States, Mexico, and Venezuela.

PUCCINIA LANTANAE Farl., on Lantana involucrata, Jalapa: S 76615; Jutiapa: S 74921. Apparently these collections are the first record of this common microcyclic rust in Guatemala.

PUCCINIA LATERITIA B. & C., on Borreria laevis, Chimaltenango: S 80002; Quezaltenango: S 84867, 87119; Sacatepéquez: S 64280; on B. ocymoides, Jalapa: S 77521; Sacatepéquez: J 320, S 58036; on B. suaveolens, Chimaltenango: S 80959; Solola: J 83; on B. verticillata, Sacatepéquez: S 58596, 60241; on B. sp., Solola: J 87; on Crusea calocephala, Guatemala: H 684; on Diodia sarmentosa, Alta Verapaz: S 91694; on Diodia teres, Jalapa: S 76634; Jutiapa: S 75089; Zacapa: S 74762; on Diodia sp., Izabal: K 4617; on Spermacoce podocephala, Solola: H 139, 662. Common in the warmer regions of North and South America and known from Africa. The species is microcyclic.

PUCCINIA LAURIFOLIAE Davidson, on Heteropteris laurifolia, Guatemala: K (type). For a description and illustration see Davidson (21). The species is distinct from P. picturata Jacks. & Holw. Known only from the type.

PUCCINIA LEVIS (Sacc. & Bizz.) Magn., on Paspalum humboldtianum, Guatemala: H 864; Solola: H 129; on Tricholaena rosea, Chimaltenango: S 79766, 79909; Jalapa: S 76809; Sacatepéquez: J 65, S 63848. The aecial stage is unknown. Widely distributed in the Americas and perhaps elsewhere.

PUCCINIA LIBERTA Kern, on Eleocharis geniculata, Quezaltenango: K 5419; on E. sp., Guatemala: J 1430. For a photograph of teliospores of the type specimen collected in Nicaragua see Cummins (9). Occurs from California to Venezuela. The aecial stage is unknown.

PUCCINIA LITHOSPERMI Ellis & Kellerm., on Evolvulus alsinoides, Zacapa: S 74764; on E. nummularius, Retalhuleu: S 88053. Not recorded for Guatemala previously. Widely distributed.

PUCCINIA MACRA Arth. & Holw., on Paspalum candidum, Solola: H 168 (type). Known also from Costa Rica and South America. For a review of this and related species and for a photograph of teliospores of the type see Cummins (19).

PUCCINIA MALVACEARUM Bert., on Sida spinosa, Guatemala: H 488. A common microcyclic species.

PUCCINIA MARSDENIAE Diet. & Holw., on Marsdenia mexicana, Guatemala: K; Solola: H 171, 677. Known otherwise only from the type collected in Mexico on the same host.

PUCCINIA MEDELLINENSIS Mayor, on Hyptis brevipes, Izabal: S 72115; on H. capitata, Izabal: K 5309; on H. pectinata, Guatemala: H 465, K 5310; Quezaltenango: H 795; Sacatepéquez: H 68; on H. polystachya, Guatemala: K 4327, 5311, 5443; on H. suaveolens, Jutiapa: S 75103. Known from Central and South America and the the West Indies.

PUCCINIA MELAMPODII Diet. & Holw., on Melampodium divaricatum, Escuintla: Donnell-Smith; Izabal: K 5338; Jutiapa: S 74836; Suchitepéquez: H 515; on M. longifolium, Sacatepéquez: J 387a; on Synedrella nodiflora, Jutiapa: S 75029; Sacatepéquez: J 1923a. The species is microcyclic. Generally distributed from Texas southward into South America.

PUCCINIA MELANTHERAE P. Henn., on *Melanthera nivea*, Sacatepéquez: H 69, S 64673. Apparently an infrequent species and difficult to distinguish, in the aecial and uredial stages, from *Uromyces columbianus*. The aecial stage, which has not been described before, is present in the Holway collection, along with uredia and telia, and is as follows: pycnia epiphyllous, few, 80-125 μ diam.; aecia hypophyllous, few in groups on dark spots, bullate, apparently without peridia; aeciospores globoid or broadly ellipsoid, 18-24 x 20-26 μ; wall 1.5-2 μ, very pale yellowish, moderately verrucose with the warts tending to unite in irregular patterns.

PUCCINIA MENTHAE Pers., on *Micromeria brownei*, Huehuetenango: S 81346, 82415; El Quiché: J 1450. This is the first report of the species for Guatemala. Widely distributed.

PUCCINIA MITRATA Syd., on *Salvia compacta*, Quezaltenango: S 83239, 83808, 83942, 85750; on *S. polystachya*, Quezaltenango: H 95; Solola: H 120; on *S. purpurea*, Alta Verapaz: S 69550, 89998, 90053, 91468; Chimaltenango: J 870, S 79758, 81059; Quezaltenango: S 67115, 67253; Sacatepéquez: J 70; Solola: H 186; on *S.* sp., Quezaltenango: H 724, 825. Reported from Mexico, Costa Rica, and Bolivia.

PUCCINIA MODICA Holw., on *Arenaria alsinoides*, Sacatepéquez: H 561; on *A. lanuginosa*, Solola: H 111. Described from Mexico and also reported for South America. Jackson (26), reduced this name to synonymy under *P. arenariicola* (P. Henn.) Jacks., a name which is non-valid because applied to a *Carex* rust by Plowright in 1889.

PUCCINIA NESODES Arth. & Holw., on *Castilleja communis*, Sacatepéquez: H 551, S 59836; Solola: H 673; on *C. tenuiflora*, Sacatepequez: H 653; Solola: H 125; on *C.* sp., Solola: H 669; on *Lamourouxia viscosa*, Sacatepéquez: S 58598, 60289. This species is microcyclic. Described and otherwise known only from Costa Rica.

PUCCINIA NIVEOIDES Cumm., on *Salvia cinnabarina*, Guatemala: S 59243 (type); Sacatepéquez: J 218. Known only from the above collections. For a description see Cummins (15). The species is microcyclic and similar to *P. delicatula*.

PUCCINIA NOCCAE Arth., on *Lagascea helianthifolia* var. *suaveolens*, Chimaltenango: S 79729a; Guatemala: H 12a, 463, K 5377, 5453; Huehuetenango: S 83026; Jalapa: S 77364; Sacatepéquez: K 5361, S 63324; Solola: H 155. Known also from El Salvador, Mexico, and South America.

PUCCINIA NOTHA Jacks. & Holw., on *Vernonia leiocarpa*, Guatemala: H 21, 495, 585a; Huehuetenango: H 759; Quezaltenango: H 732; Sacatepéquez: H 550; Solola: H 148 (type); Totonicapán: S 84049; on *V. shannoni*, Quezaltenango: H 814, S 84227; on *V. standleyi*, Jutiapa: S 74896; Santa Rosa: S 78357. Reported otherwise from Socorro Island in the Pacific.

PUCCINIA NOTICOLOR Holw., on *Ipomoea fistulosa*, Guatemala: H 40; on *I. morelii*, Quezaltenango: S 86782; on *I. murucoides*, Jalapa: S 76395; on *I. parasitica*, Zacapa: S 74611. Known otherwise from El Salvador and Mexico. Uredia are not formed.

PUCCINIA OAXACANA Diet. & Holw., on Archibaccharis asperifolia, Guatemala: H 32, 46; on A. torquis, Quezaltenango: H 826. Known also from Costa Rica and Mexico.

PUCCINIA OBESISPORA Arth., on Alternanthera philoxeroides, Alta Verapaz: von Tuerckheim (type of Uredo nitidula Arth.); on A. obovata, Alta Verapaz: S 69416, 71552. All three specimens are from Cobán. Known otherwise from the type collected in Mexico.

PUCCINIA OBLATA Mains, on Otopappus curviflorus, Izabal: Deam 89A (type). This species differs from P. cornuta in having white aecia, aeciospores with uniform walls, uredia in the life cycle and different habit. For a description see Mains (41). Known also from British Honduras.

PUCCINIA OBLIQUA B. & C., on Funastrum crassifolium, Guatemala: H 197, 198, K 4348, 5437; on Metastelma pedunculare, Jutiapa: S 75625; on Vincetoxicum sp., Chimaltenango: S 79847, 79854, 80220; Guatemala: H 45; Suchitepéquez: H 519; Solola: H 192; on undet. Asclepiadaceae, Chimaltenango: J 1686, 1792. This microcyclic species often causes distortion of the host.

PUCCINIA OBSCURATA Arth. & Holw., on Neonelsonia ovata, Chimaltenango: S 61809; Dept. unknown: K; Sacatepéquez: H 555 (type). Although not so described the teliospores are commonly diorchidioid. Known only from Guatemala. As Sydow (44) pointed out, Jackson's (29) Ecuadorian record represents an error in identification. For a description of the aecial stage see Cummins (15).

PUCCINIA OBTECTELLA Cumm., on Scirpus americanus, Guatemala: S 61342 (type). Known only from the type. For a description see Cummins (15).

PUCCINIA ORDINATA Jacks. & Holw., on Calea insignis, Quezaltenango: H 817 (type); on C. integrifolia, Chimaltenango: S 80263; Quezaltenango: H 790; El Quiché: J 1454; San Marcos: S 66225: Solola: H 145. Reported only for Guatemala. The species is microcyclic.

PUCCINIA OXALIDIS (Lév.) Diet. & Ellis, on Oxalis divergens, Alta Verapaz: S 71562; Chimaltenango: S 80003, 80076; Sacatepéquez: S 58013; on O. latifolia, Quezaltenango: S 87920; on O. sp., Chimaltenango: J 8, 94. The aecial stage, which occurs on Mahonia (Berberis), has not been found in Guatemala. Known from the warmer regions of North and South America and in greenhouses as far north as Massachusetts.

PUCCINIA PALLESCENS see ANGIOPSORA PALLESCENS.

PUCCINIA PALLIDISSIMA Speg., on Stachys agraria, Chimaltenango: S 80070; on S. lindenii, Quezaltenango: H 805. Infrequent but known to occur from Texas to Chile and Argentina. The species is microcyclic.

PUCCINIA PALLOR Arth. & Holw., on Bomarea acutifolia, Sacatepéquez: H 84, 562 (type), K 4611, 5413; on B. caldasii, Sacatepéquez: J 198, 598, S 65140; San Marcos: S 68659. Known otherwise only from Costa Rica and Bolivia.

PUCCINIA PARILIS Arth., on Hyptis stellulata, Santa Rosa: H 848. Described and otherwise known from Mexico.

PUCCINIA PASPALICOLA Arth.: Specimens distributed under Angiopsora compressa, P. dolosa and P. substriata. For a review of this group see Cummins (19).

PUCCINIA PAULENSIS Rangel, on Capsicum annuum, Sacatepéquez: K 7104, 7438. These collections were reported by Davidson (21). Known also from South America. The species does not form uredia. For a description see Rangel (42).

PUCCINIA PAUPERCULA Arth., on Pseudelephantopus spicatus, Jutiapa: S 75179; Suchitepéquez: H 510, 530. The species is microcyclic. Occurs from Mexico to Panama.

PUCCINIA PLUCHEAE (Syd.) Arth., on Pluchea odorata, Guatemala: K 5388. Known from Florida, the West Indies, Guatemala, and South America.

PUCCINIA POAE-SUDETICAE (Westend.) Jørstad, on Poa annua, Chimaltenango: S 80207; Guatemala: H 36; Quezaltenango: S 84598. This species has usually been recorded in American literature as P. epiphylla (P. poarum), an European species. The aecial stage is not known. Widely distributed.

PUCCINIA POIKILOSPORA Cumm., on Smilax jalapensis, Quezaltenango: S 85509; on S. spinosa, Jutiapa: J 1425 (type). Known only from Guatemala. For a description and for a photograph of teliospores of the type see Cummins (12).

PUCCINIA POLYGONI-AMPHIBII Pers., on Polygonum meisnerianum, Baja Verapaz: S 90963; on P. punctatum, Baja Verapaz: S 69595, 91157; Guatemala: K 5392; Retalhuleu: S 87511; on P. sp., Huehuetenango: J 1706. The aecial stage occurs on Geranium in the more northern range of the species. Widely distributed.

PUCCINIA POLYSORA Underw., on Euchlaena mexicana, Guatemala: K 5077; on Tripsacum dactyloides, Chimaltenango: S 80903; on Zea mays, Guatemala: K 5474. For distribution, discussion and a photograph of telia of the type see Cummins (17). The aecial stage is not known.

PUCCINIA POROPHYLLI P. Henn., on Porophyllum ruderale, Jutiapa: S 75691; on P. sp., Zacapa: K 6116. Davidson (21) first reported this species for Guatemala, based on Kellerman's collection. He also states that what appears to be the same rust is present in the National Herbarium on a specimen of P. nummularius, collected by Blake at Gualan, Zacapa. Davidson also records the presence of the aecial stage but without a detailed description. Known also from Mexico and South America.

PUCCINIA PRAEALTA Jacks. & Holw., on Vernonia triflosculosa, Retalhuleu: S 88731; Suchitepéquez: H 510 (type). Known also from Costa Rica and El Salvador.

PUCCINIA PRIONOSCIADII Lindr., on Prionosciadeum cuneatum, Chimaltenango: J 233, 772, 772a, Sacatepéquez: S 59410; on P. thapsoides, Chimaltenango: S 80132. Known otherwise from Mexico.

PUCCINIA PROBA Jacks. & Holw., on Wedelia filipes, Retalhuleu: S 88747; on Zexmenia elegans, Chiquimula: S 74750; Izabal: K 4383, 5332, 5352, [illegible], Retalhuleu: H 531, 689, 698, 700, 714; on Z. frutescens, Alta Verapaz: von Tuerckheim; Chimaltenango: J 856; Izabal: Deam 302, H 601; Sacatepéquez: J 70,

S 63354; Solola: H 109; on _Z. salvinii_, Chimaltenango: S 79950; Guatemala: H 847; Huehuetenango: S 82411; on _Z_ sp., Chimaltenango: J 848. The species has teliospores somewhat variable in size; in Standley's no. 63354 they are frequently variably 3-celled. Known also from Costa Rica and Mexico.

PUCCINIA PULSATILLAE Kalchbr., on _Ranunculus hookeri_, Chimaltenango: J 1464, 1762, S 57777, 60065. The four collections are all from the region of Las Calderas. First reported for Guatemala by Cummins (15) and not otherwise known to occur south of the United States although a widely distributed rust. The species is microcyclic.

PUCCINIA PUNCTATA Link on _Galium_ sp., Chimaltenango: J 734, K; Sacatepéquez: K 7196. Apparently this species has not been reported previously for Guatemala, although Kellerman's collections are old. Widely distributed.

PUCCINIA PUNCTIFORMIS Diet. & Holw., on _Rumex crispus_, Solola: H 116, 676. Known also from Mexico, the United States, and Russia.

PUCCINIA PURPUREA Cooke, on _Sorghum halepense_, Chimaltenango: J 1702; Guatemala: S 92862; on _S. vulgare_, Chimaltenango: S 80311, 80314; Jutiapa: S 85378; Sacatepéquez: K 6074; on _Tripsacum latifolium_, Guatemala: K. This common rust has apparently not been recorded previously for Guatemala or as on _Tripsacum_. The determination of the host of Kellerman's collection as _T. latifolium_ was made by Mrs. Chase in 1917. Widely distributed.

PUCCINIA RATA Jacks. & Holw., on _Vernonia leiocarpa_, Chimaltenango: S 79780; Guatemala: H 490 (type), 495a, 585, 860; Sacatepéquez: K 6300, S 63871. Known only from Guatemala.

PUCCINIA REPENTINA Jacks. & Holw., on _Arracacia bracteata_, Santa Rosa: S 77904. Known otherwise only from the type collected in Bolivia. For the original description see Jackson (29); for additional notes and a photograph of teliospores see Cummins (20).

PUCCINIA RUBIGO-VERA (DC.) Wint., on _Trisetum deyeuxioides_, Guatemala: H 35, 85; Sacatepéquez: K 5322; on _Triticum aestivum_, Chimaltenango: J; Quezaltenango: S 83448, 83758, 84207. The aecial stage has not been collected in Guatemala. World wide in distribution.

PUCCINIA RUELLIAE (B. & Br.) Lagerh., on _Blechum brownei_, Guatemala: K 5400; on _Justicia inaequalis_, Chimaltenango: J 1904; on _J._ sp., Retalhuleu: H 691. The morphological limits of this species are not well defined. The rust on _Blechum_ is frequently considered as a distinct species, _P. blechi_, and the collections on _Justicia_ do not agree too well with collections on _Ruellia_.

PUCCINIA SALVIICOLA Diet. & Holw., on _Salvia occidentalis_, Sacatepéquez: S 63043. Not reported previously for Guatemala but represented only by uredia and, therefore, the record should be accepted with reservation. Known also from Florida, Texas, Mexico, and possibly Colombia.

PUCCINIA SANGUINOLENTA P. Henn., on Bunchosia sp., Dept. unknown: K. Not reported previously for Guatemala or as occurring on Bunchosia. A Mexican species, P. rubricans, is similar and perhaps synonymous. Known also from Brazil.

PUCCINIA SCHISTOCARPHAE Jacks. & Holw., on Schistocarpha platyphylla, Guatemala: H 42 (type); Sacatepéquez: H 35, 571; on S. sp., Chimaltenango: S 80243; Quezaltenango: H 799, 834. Reported also from Colombia. The species is microcyclic.

PUCCINIA SCLERIAE (Paz.) Arth., on Scleria setuloso-ciliata, Chiquimula: S 74715a; on S. sp., Dept. unknown: K. Not previously reported for Guatemala. The aecial stage occurs on Passiflora spp. Known from Central and South America, the West Indies, the Philippines, and New Guinea.

PUCCINIA SEMOTA Jacks. & Holw., on Hymenostephium cordatum, Chimaltenango: S 80227, 80257; Solola: H 146 (type). Known only from the above collections. The species is microcyclic.

PUCCINIA SENECIONICOLA Arth., on Cacalia calotricha, Sacatepéquez: H 570; on C. sp., Guatemala: H 632, 845; Huehuetenango: H 771: Quezaltenango: H 794, 827, 835, 836; on Senecio acutangulus, Huehuetenango: S 81563, 82423, 82499; Quezaltenango: S 83304; on S. heterogamus, Quezaltenango: S 84247; on S. petasioides, Chimaltenango: J 74, 249, 372, 613, S 64398, 79784, 79954; Guatemala: K; Quezaltenango: House 5201, K 5418, S 65546, 83224, 83955, 83960, 84805, 85645, 86135, 87069; Sacatepéquez: S 58960, 59825; San Marcos: S 66132; Solola: K 5442; on S. platanifolia, Huehuetenango: S 82669; on S. sarmentosae, Sacatepéquez: J 1921: on S. warscewiczii, Quezaltenango: K 5445, S 84721; on S. sp., Guatemala: H 10, 47; Quezaltenango: H 93, 96A, 728, 781; 784. Common also in Mexico and reported for El Salvador.

PUCCINIA SENILIS Arth., on Lippia myriocephala, Guatemala: K 5451 (type). Known only from this one meagre specimen. Future collections may prove the species to be a Prospodium.

PUCCINIA SEORSA Jacks. & Holw., on Piptocarpha chontalensis, Izabal: S 72528. Known otherwise from Brazil. For a description of the species see Jackson (30), for notes on the above aecial collection see Cummins (15).

PUCCINIA SETARIAE Diet. & Holw., on Setaria sp., Chimaltenango: J 1699. Not previously reported for Guatemala. For a recent discussion of the species and a photograph of teliospores of the type see Cummins (19).

PUCCINIA SHERARDIANA Körn., on Malvastrum coromandellianum, Guatemala: J 1688, S 80449; Jalapa: S 77179; Santa Rosa: S 77841. Not previously reported for Guatemala but common in the Americas. The species is microcyclic.

PUCCINIA SOLIDIPES Jacks. & Holw., on Eupatorium areolaria DC. (E. tubiflorum), Guatemala: H 18; Quezaltenango: H 793: Sacatepéquez: H 557 (type); Solola: K 5314. Known otherwise from three Mexican collections, none with telia.

PUCCINIA SORGHI Schw., on Euchlaena mexicana, Chimaltenango: J 1905;

on Zea mays, Chimaltenango: J 1968. See also Angiopsora zeae and Puccinia polysora which have, at times, been confused with this species. For a photograph of teliospores of the type see Cummins (17).

PUCCINIA SPEGAZZINIANA De T., on Eleutheranthera ruderalis, Santa Rosa: S 77789. This is the first North American collection and the first on this host. For notes and a photograph of teliospores see Cummins (20). Known otherwise from South America.

PUCCINIA SPEGAZZINII De T., on Mikania cordifolia, Guatemala: H 496, 622, 843, K 5402; Huehuetenango: S 82998. Occurs from the southern United States southward into South America. The species is microcyclic.

PUCCINIA SUBAQUILA Jacks. & Holw., on Wedelia acapulcensis, Jutiapa: S 75205. Recorded previously only from South America. Only uredia are present so that the determination can be only tentative. For a description see Jackson (30).

PUCCINIA SUBDIGITATA Arth. & Holw., on Brachypodium mexicanum, Guatemala: H 23 (type). Recorded otherwise for Bolivia and Colombia. The aecial stage is not known.

PUCCINIA SUBSTRIATA Ellis & Kellerm., on Solanum diversifolium, Izabal: S 24085; on S. hispidum, Chimaltenango: J 771, 1906; on S. ochraceo-ferrugineum, Alta Verapaz: S 91799; on S. torvum, Izabal: H C, K 4621; on Paspalum affine, Sacatepéquez: S 63781; on P. langei, Alta Verapaz: S 90063; on P. paniculatum, H 595; on Valota insularis, Guatemala: K 5368; Santa Rosa: H 857. Proof of the relationship of the aecial stage on Solanum and the telial stage on Paspalum was provided by Thomas' (46) cultures made in Puerto Rico. The species has been cited as P. tubulosa and P. paspalicola and has had various names listed in its synonymy. For a review of this and related species and for photographs of teliospores, including those of the type, see Cummins (19).

PUCCINIA TAGETICOLA Diet. & Holw., on Tagetes tenuifolia, Chimaltenango: J 159, S 79723; Jalapa: S 76507, 77386. Apparently not previously recorded for Guatemala. Known from Mexico, Costa Rica, the West Indies, and South America.

PUCCINIA TETRAMERII Seym., on Tetramerium hispidum, Guatemala: S 89418. This is the first record of the species south of Mexico. Occurs northward to Arizona.

PUCCINIA TITHONIAE Diet. & Holw., on Tithonia diversifolia, Guatemala: H 60, 65: Retalhuleu: H 701; on T. longeradiata, Jalapa: S 77226; Quezaltenango: S 87096; on T. rotundifolia, Alta Verapaz: S 69445, 69555; Chimaltenango: S 64329; Huehuetenango: S 82987; Jalapa: S 76505; Retalhuleu; H 696, 715; Suchitepéquez: H 514, 526; Santa Rosa: S 77692, 79407; on T. scaberrima, Quezaltenango: H 729; on T. tubaeformis, Guatemala: H 606, K 4328, 5425; Sacatepéquez: H 70. Known also from Costa Rica and Mexico.

PUCCINIA TOLIMENSIS Mayor, on Eupatorium pansamalensis, Quezaltenango: H 802; on E. pycnocephaloides, Quezaltenango: S 84325a; on

E. pycnocephalum, Quezaltenango: S 85119; on E. sp., Guatemala: H 22; Quezaltenango: H 806. Known also from New York, Colombia, Bolivia, and Ecuador. The species is microcyclic.

PUCCINIA TRINIOCHLOAE see UREDO TRINIOCHLOAE.

PUCCINIA TRIXITIS (Kern & Kellerm.) Arth., on Trixis frutescens, Quezaltenango: H 725; Sacatepéquez: H 71, 581; Solola: H 103, K 5432 (type); on T. radialis, Quezaltenango: S 83228, 85786; Sacatepéquez: S 64272. Known only from Guatemala.

PUCCINIA URBANIANA P. Henn., on Cornutia grandifolia, Chiquimula: Standley 74719; Quezaltenango: H 822; Santa Rosa: S 77997; on Stachytarpheta frantzii, Jutiapa: S 74934, 75483, 78481; Santa Rosa: S 77688, 78831, 79258; on S. jamaicensis, Alta Verapaz: von Tuerckheim 1027, 7934. The species is microcyclic. Occurs from Florida into South America.

PUCCINIA VARIA (Diet.) Arth., on Jacobina sp. or Ruellia sp., Solola: H 160; on undet. Acanthaceae: K 5347. The original collection (Uredo varia Diet.) was made in Brazil. Both Guatemalan specimens have telia and are the only telial collections. There is, in the Arthur Herbarium, also a collection on Aphelandra sinclairiana? from Costa Rica.

PUCCINIA VELATA (E. & E.) Arth., on Euphorbia ephedromorpha, Jalapa: S 76466, 77147; on E. graminea, Chimaltenango: J 1967, S 80281. The species was recorded for Guatemala on Aklema (Euphorbia) scotana in the North American Flora but the host is E. cotinifolia and the rust (Kellerman 5433) P. euphorbiae var. longipes. Recorded also from Mexico, the West Indies, and Hawaii.

PUCCINIA VERGRANDIS Arth. & Holw., on Saurauia pauciserrata, Quezaltenango: H 820 (type). Known only from the type.

PUCCINIA VIOLAE (Schum.) DC., on Viola nannei, Sacatepéquez: H 566, 656, S 65116; on V. pringlei, Sacatepéquez: J 196. The above collections are all from Volcán de Agua. Widely distributed.

PUCCINIA WATTIANA Barcl., on Clematis dioica, Solola: K 5428. This microcyclic species has been reported previously only from the Orient. The specimen was collected by Kellerman on Volcán Atitlan, Feb. 16, 1906 and was found in a box of unidentified material in the Arthur Herbarium. The host was recently identified by Standley.

PUCCINIA ZEXMENIAE Diet. & Holw., on Zexmenia frutescens (Z. costaricensis), Guatemala: K 5452. Known also from Mexico and El Salvador.

PUCCINIASTRUM AGRIMONIAE (Schw.) Tranz., on Agrimonia macrocarpa, Chimaltenango: J 1899. Not previously recorded for Guatemala but the species is widely distributed. The aecial stage is not known but the aecial host will undoubtedly be Abies, Picea, or Tsuga.

PUCCINIASTRUM FUCHSIAE (Arth. & Holw.) Hirats., on Fuchsia splendens, Sacatepéquez: H 563 (type); on Lopezia hirsuta, Sacatepéquez: H 649. Neither the aecial stage nor the telia are known for this species. Reported also from Costa Rica and on greenhouse plants in Ohio.

PUCCINIASTRUM MYRTILLI (Schum.) Arth., on Pernettia ciliata, Chimaltenango: J 518. Not previously recorded for Guatemala. The species is widely distributed. The aecial stage occurs on Tsuga in more northern regions.

PUCCINIASTRUM SPARSUM (Wint.) Fischer, on Arbutus xalapensis, Chimaltenango: J; on A. sp., Quezaltenango: H 121. The aecial stage occurs on Picea but has not been collected in America. Widely distributed.

PUCCINIOLA see UROMYCES.

PUCCINIOSIRA BRICKELLIAE Diet. & Holw., on Brickellia adenocarpa, Chimaltenango: J 743, 849, 871, 879, S 79769, 79955; Guatemala: H 466, K 5333, 5468; Huehuetenango: H 755; Quezaltenango: H 92, 783, S 83929; El Quiché: J 1451; Sacatepéquez: S 63849; Sololá: H 151; on B. cavanillesii, Quezaltenango: K 5448. Known also from El Salvador and Mexico.

PUCCINIOSIRA EUPATORII Lagerh., on Eupatorium sp., Santa Rosa: S 60457. Guatemalan collections first reported as this species by Arthur (2) were later (5) transferred to Baeodromus eupatorii and P. eupatorii was cited, incorrectly, as a synonym of B. eupatorii. For a recent redescription of the species see Cummins (15). Known otherwise from South America.

PUCCINIOSIRA PALLIDULA (Speg.) Lagerh., on Heliocarpus sp.: Guatemala: J 1689; on Triumfetta dumetorum, Chimaltenango: S 80015; Jalapa: S 76711; Jutiapa: S 75239, 75707; Quezaltenango: S 84855; Santa Rosa: S 78091; on T. lappula, Chimaltenango: J 131; Santa Rosa: S 79260; on T. semitriloba, Chiquimula: S 74707; Jutiapa: S 75007; Suchitepéquez: H 509; on T. sp., Guatemala: K 4608; Sacatepéquez: J 872, 877. Known from Mexico, the West Indies, and Central and South America.

PYROLA SECUNDA var. ELATIOR Lange: Chrysomyxa pyrolae.

QUAMOCLIT COCCINEA (L.) Moench: Coleosporium ipomoeae.

QUERCUS CORRUGATA Hook., TOMENTOSA Willd.: Cronartium quercuum.

RANNUNCULUS HOOKERI Schl.: Puccinia pulsatillae.

RAVENELIA ACACIAE-PENNATULAE Diet., on Acacia pennatula, Jalapa: K 7898; Sololá: H 162. Known also from Mexico.

RAVENELIA ANTIGUANA Cumm., on Cassia biflora, Sacatepéquez: S 63356 (type). Known only from the type. For a description of the species and for a photograph of teliospore-heads see Cummins (15).

RAVENELIA APPENDICULATA Lagerh. & Diet., on Phyllanthus conami (acuminatus), Retalhuleu: H 699; on P. sp., Guatemala: H 616; Sololá: H 127, 671. Reported also from Mexico and South America.

RAVENELIA BIZONATA Arth. & Holw., on Calliandra houstoniana, Guatemala: H 584 (type); on C. sp., Huehuetenango: H 762. Known only from Guatemala.

RAVENELIA DISTANS Arth. & Holw., on undet. Mimosaceae, Retalhuleu: H 535 (type). Known only from the type.

RAVENELIA ECTYPA Arth. & Holw., on Calliandra chapaderoana, Jalapa: S 77381; on C. gracilis, Guatemala: H 633; on C. sp., Guatemala: H 204. Originally described from Costa Rica and known also from Bolivia.

RAVENELIA ENTADAE Lagerh. & Diet., on Entada sp., Suchitepéquez: H 517. Recorded also for Panama.

RAVENELIA HUMPHREYANA P. Henn., on Caesalpinia pulcherrima, Jalapa: K 7668; Santa Rosa: K 7734; Zacapa: K 5427, S 74784. Known also from Costa Rica, Mexico, the West Indies and Florida.

RAVENELIA IGUALICA Arth., on Acacia angulosa, Huehuetenango: S 81922; on A. filicioides, Quezaltenango: H 97; Solola: H 119; on A. sp., Santa Rosa: S 77983. Known also from Mexico and Texas.

RAVENELIA INCONSPICUA Arth., on Caesalpinia exostemma, Guatemala: H 476. Known also from El Salvador and Mexico.

RAVENELIA INDIGOFERAE Tranz., on Indigofera mucronata, Solola: H 122; on I. suffruticosa, Guatemala: H 637; on I. sp., Sacatepéquez: H 640; Solola: H 667. Known also from Arizona, Mexico, the West Indies, and South America.

RAVENELIA INGAE see BITZEA INGAE, UREDO INGAE.

RAVENELIA INQUIRENDA Arth. & Holw., on Acacia bursaria, Guatemala: H 196 (type). Known only from the type.

RAVENELIA LEUCANAE-MICROPHYLLI Diet., on Acacia angustissima, Guatemala: H 9; Solola: H 138, 674. Reported also from Mexico and Brazil.

RAVENELIA LONCHOCARPI Lagerh. & Diet., on Lonchocarpus sp., Suchitepéquez: H 511, 522. Reported also from the West Indies, El Salvador, and Brazil.

RAVENELIA MAINSIANA Arth. & Holw., on Mimosa albida, Guatemala: H 13 (type). Recorded otherwise for El Salvador.

RAVENELIA MERA Cumm., on Lonchocarpus michelianus, Jutiapa: S 75109 (type); on L. rugosus, Retalhuleu: H 706. Holway's collection was reported by Arthur (2) as R. similis and the host as Brongniartia. The host was corrected by Standley in 1939. For a description see Cummins (20). Known only from Guatemala.

RAVENELIA MIMOSAE-ALBIDAE Diet., on Mimosa albida (M. floribunda), Baja Verapaz: K; Chimaltenango: J 161, 778; Jalapa: K; Jutiapa: S 74994; Sacatepéquez: K 5360, S 60302; Solola: H 137. Known also from Costa Rica, Mexico, and South America.

RAVENELIA SILIQUAE Long, on Vachellia farnesiana, Guatemala: H 199; El Quiché: J 1449; Santa Rosa: H 850. Known also from Texas, Mexico, Cuba, Puerto Rico, and Hawaii.

RAVENELIA SIMILIS see R. MERA.

RAVENELIA SOLOLENSIS Arth. & Holw., on Lysiloma acapulcensis, Solola: H 147 (type). Known only from the type.

RAVENELIA SPINULOSA Diet. & Holw., on Cassia biflora, Guatemala: H 867, K; Jalapa: H 209; Retalhuleu: S 88714; Santa Rosa: S 77915, 78552; Solola: H 134, 182; Zacapa: K 5441; on C. nicaraguensis, Chiquimula: S 74728; El Quiché: J 1447; on C. sp., Guatemala: H 44. Known also from the West Indies, Mexico, and Venezuela.

RONDELETIA CORDATA Benth.: Uredo rondeletiae.

ROSA sp.: Phragmidium disciflorum.

RUBUS ADENOTRICHUS Schl.: Mainsia rubi.

RUBUS AMPLIOR Rydb.: Kuehneola arthuri, Mainsia rubi.

RUBUS CORIIFOLIUS Liebm.: Mainsia rubi.

RUBUS ERIOCARPUS Liebm.: Mainsia epiphylla, M. rubi.
RUBUS GLAUCUS Benth.: Mainsia rubi.
RUBUS IRASUENSIS Liebm.: Mainsia holwayi, M. rubi, M. standleyi.
RUBUS LAXUS Rydb., MISER Liebm., POLICPHYLLUS Focke, PRINGLEI Rydb.: Mainsia rubi.
RUBUS SCHIEDEANUS Steud.: Kuehneola arthuri.
RUBUS TRILOBUS Ser.: Phragmidium occidentale.
RUBUS TUERCKHEIMII Rydb.: Kuehneola guatemalensis, Mainsia rubi.
RUBUS sp.: Kuehneola arthuri, K. loeseneriana, Mainsia pittieriana, M. rubi.
RUELLIA sp.: Puccinia varia.
RUMEX CRISPUS L.: Puccinia punctiformis.
RYNCHOSPORA POLYPHYLLA Vahl: Puccinia angustata var. angustatoides.
RYNCHOSPORA ROBUSTA (Kunth) Boeckl.: Puccinia cladii.
SALIX BONPLANDIANA H.B.K.: Melampsora ribesii-purpureae.
SALIX CHILENSIS Mol., TAXIFOLIA H.B.K.: Melampsora abieti-capraearum.
SALMEA SCANDENS (L.) DC.: Uromyces salmeae.
SALVIA ALBIFLORA M. & G.: Puccinia degener.
SALVIA AMARISSIMA Ort.: Puccinia farinacea.
SALVIA CINNABARINA M. & G.: Puccinia delicatula, P. infrequens, P. niveoides.
SALVIA COMPACTA Kuntze: Puccinia mitrata.
SALVIA ELEGANS Vahl: Puccinia delicatula, P. farinacea.
SALVIA GRACILIS Benth.: Puccinia cuilapensis.
SALVIA HISPANICA L.: Puccinia mitrata.
SALVIA HOLWAYI Standl.: Puccinia delicatula, P. farinacea.
SALVIA INVOLUCRATA Cav.: Puccinia filiola.
SALVIA KELLERMANI D. Sm., LAVANDULOIDES H.B.K., LINDENII Benth.: Puccinia farinacea.
SALVIA MOCINOI Benth.: Puccinia cuilapensis.
SALVIA MYRIANTHA Epling: Puccinia degener.
SALVIA NEPETOIDES H.B.K.: Puccinia farinacea.
SALVIA NERVATA M. & G.: Puccinia filiola.
SALVIA OCCIDENTALIS Sw.: Puccinia impedita, P. salviicola.
SALVIA PATENS Cav.: Puccinia farinacea.
SALVIA POLYSTACHYA Ort.: Puccinia mitrata.
SALVIA PULCHELLA DC.: Puccinia delicatula, P. filiola.
SALVIA PURPUREA Cav.: Puccinia mitrata.
SALVIA RIPARIA Kunth: Puccinia farinacea.
SALVIA TILIAEFOLIA Vahl: Puccinia impedita.
SALVIA URICA Epling: Puccinia infrequens.
SAURAUIA CONZATTII Busc., COSTARICENSIS D. Sm.: Puccinia hiascens.
SAURAUIA PAUCISERRATA Hemsl.: Puccinia hiascens, P. vergrandis.
SAURAUIA SMITHIANA Busc.: Puccinia hiascens.
SCHISTOCARPHA PLATYPHYLLA Greenm.: Puccinia schistocarphae.
SCIRPUS AMERICANUS Pers.: Puccinia obtectella.
SCLERIA BRACTEATA Cav.: Uromyces scleriae.
SCLERIA SETULOSO-CILIATA Boeckl.: Puccinia scleriae.
SENECIO ACUTANGULUS Hemsl.: Puccinia senecionicola, Uromyces senecionicola.

SENECIO HETEROGAMUS Hemsl., PETASIOIDES Greenm., PLATANIFOLIA Benth., SANTAROSAE Greenm.: Puccinia senecionicola.
SENECIO WARSCEWICZII A. Br. & Bouché: Baeodromus holwayi, Puccinia senecionicola.
SENITES see ZEUGITES.
SERJANIA ATROLINEATA Sauv. & Wright, CARACASANA (Jacq.) Willd., RACEMOSA Schum.: Puccinia arechavaletae.
SETARIA sp.: Puccinia setariae.
SIDA CILIARIS L., CORDIFOLIA L.: Puccinia heterospora.
SIDA SPINOSA L.: Puccinia malvacearum.
SIMSIA FOETIDA (Cav.) Blake, HOLWAYI Blake, LAGASCAEFORMIS DC., POLYCEPHALA Benth., SERICEA (Hemsl.) Blake: Puccinia enceliae.
SKIERKA HOLWAYI Arth., on Thouinidium decandrum, Guatemala: H 475, K; Retalhuleu: S 88415; on T. sp., Santa Rosa: H 849 (type). Known also from El Salvador, Honduras, and Mexico. For a recent review, with illustrations, of the genus Skierka see Mains (40).
SMILAX JALAPENSIS Schl.: Puccinia poikilospora.
SMILAX SPINOSA Mill.: Puccinia poikilospora, Sphenospora yurimaguasensis.
SOLANUM APPENDICULATUM Dunal: Uromyces solani.
SOLANUM DIVERSIFOLIUM Schl., HISPIDUM Pers.: Puccinia substriata.
SOLANUM NUDUM H.B.K.: Uromyces solani.
SOLANUM OCHRACEO-FERRUGINEUM (Dunal) Fernald: Puccinia substriata.
SOLANUM SALVIIFOLIUM Lam.: Puccinia incondita.
SOLANUM TORVUM Sw.: Puccinia substriata.
SORGHUM HALEPENSE Pers., VULGARE Pers.: Puccinia purpurea.
SPERMACOCE PODOCEPHALA DC.: Puccinia lateritia.
SPHAEROPHRAGMIUM FIMBRIATUM Mains, on Dalbergia glabra, El Petén: Bartlett 12429A (type). Recorded also for Nicaragua. For a description of the species and for a photograph of teliospores see Mains (36).
SPHENOSPORA YURIMAGUASENSIS (P. Henn.) Jacks., on Smilax spinosa, Santa Rosa: S 78107; on S. sp., Izabal: H 859, K 7111; Retalhuleu: H 718 (type of Sphenospora smilacina Syd.) If uredial names are not to be considered as valid in determining priority then S. smilacina Syd. would be the correct binomial. Known also from Costa Rica, Trinidad, and South America.
SPIGELIA HUMBOLDTIANA C. & S.: Coleosporium spigeliae.
SPIRECHINA see MAINSIA and KUEHNEOLA.
STACHYS AGRARIA C. & S., LINDENII Benth.: Puccinia pallidissima.
STACHYTARPHETA FRANTZII Polak., JAMAICENSIS (L.) Vahl: Puccinia urbaniana.
STELIS sp.: Uredo sp.
STELLARIA OVATA Willd.: Puccinia detonsa.
STEVIA ELATIOR H.B.K., LUCIDA Lag., OVATA Willd., POLYCEPHALA Bertol., RHOMBIFOLIA H.B.K., SUBPUBESCENS Lag.: Coleosporium steviae.
STIGMAPHYLLON sp.: Puccinia circinata.
STRUTHANTHUS DENSIFLORUS (Benth). Mart., QUERCICOLA (C. & S.) Blume: Uromyces socius.
SYNEDRELLA NODIFLORA (L.) Gaertn.: Puccinia melampodii.

TAGETES TENUIFOLIA Cav.: Puccinia tageticola.
TALINUM TRIANGULARE (Jacq.) Willd.: Aecidium talini.
TECOMA MOLLIS H.B.K.: Prospodium appendiculatum.
TECOMA STANS (L.) Juss.: Prospodium appendiculatum, P. transformans.
TELEUTOSPORA see UROMYCES.
TETRAMERIUM HISPIDUM Nees: Puccinia tetramerii.
THOUINIDIUM DECANDRUM (H.B.K.) Radlk.: Skierka holwayi.
TITHONIA DIVERSIFOLIA (Hemsl.) Gray, LONGERADIATA (Bertol.) Blake, ROTUNDIFOLIA (Mill.) Blake, SCABERRIMA Benth., TUBAEFORMIS (Jacq.) Cass.: Puccinia tithoniae.
TOURNEFORTIA HIRSUTISSIMA L., : PETIOLARIS DC.: Aecidium tournefortiae.
TRADESCANTIA CUMANENSIS Kunth: Uromyces commelinae.
TRANZSCHELIA PRUNI-SPINOSAE (Pers.) Diet., on Prunus capuli, Chimaltenango: S 80321, 80805: Quezaltenango: S 83479; on P. persica, Chimaltenango: J 116, S 80808; Sacatepéquez: J 84, K 5358; on P. serotina, Guatemala: H 28; on P. sp., Chimaltenango: S 80807; Guatemala: K 4387. The aecial stage on Ranunculaceae is not known to occur in Guatemala. Widely distributed.
TRICHOLAENA ROSEA Nees: Puccinia levis.
TRIFOLIUM AMABILE H.B.K.: Uromyces trifolii.
TRINIOCHLOA STIPOIDES (H.B.K.) Hitchc.: Uredo triniochloae.
TRIPSACUM DACTYLOIDES L.: Puccinia polysora.
TRIPSACUM LATIFOLIUM Hitchc.: Angiopsora pallescens, Puccinia purpurea.
TRIPSACUM LAXUM Nash: Angiopsora pallescens.
TRISETUM DEYEUXIOIDES (H.B.K.) Kunth: Puccinia rubigo-vera.
TRISMERIA TRIFOLIATA (L.) Diels: Desmella superficialis.
TRITICUM AESTIVUM L.: Puccinia graminis, P. rubigo-vera.
TRIUMFETTA DUMETORUM Schl., LAPPULA L., SEMITRILOBA Jacq.: Pucciniosira pallidula.
TRIXIS FRUTESCENS P. Br., RADIALIS (L.) Kuntze: Puccinia trixitis.
UREDINOPSIS n. sp. inedit., on Polypodium plesiosorum, Chimaltenango: J. This species has also been intercepted in Customs as from Mexico. It will be described by Faull.
UREDINOPSIS INVESTITA Faull, on Adiantum andicola, Chimaltenango: 12983 (type). Known only from the type. For a description and illustrations see Faull's (22) recent monograph of the genus Uredinopsis.
UREDINOPSIS MACROSPERMA (Cooke) Magn. on Pteridium aquilinum, Alta Verapaz: Faull: Chimaltenango: J 712, 773, S 79980, Faull; El Quiché: J 1453; Sacatepéquez: S 63742. Pteridium aquilinum is used here in the broad sense to include varieties and marginal species as was done by Faull (22). Most Guatemalan specimens have been identified as P. caudatum. Faull also lists P. feei and Standley's no. 79980 bears the name P. aquilinum var. The aecial stage occurs on species of Abies but is not known from Guatemala, or indeed, from most of the species' range, which is practically world wide.
UREDO ANACARDII Mains on Anacardium occidentale, El Petén: Bartlett 12752 (type). Known only from the type. For a description see Mains (36).

UREDO ANTIGUENSIS Cumm., on Acalypha guatemalensis, Sacatepéquez: S 64281 (type). Known only from the type. For a description see Cummins (15).

UREDO BEHNICKIANA P. Henn., on Oncidium cavendishianum. Recorded in the N. Am. Flora as introduced into England on plants from Guatemala.

UREDO COLUBRINAE Cumm., on Colubrina ferruginosa, Quezaltenango: S 87894 (type). Known only from the type. For a description see Cummins (20).

UREDO ERYTHRINAE P. Henn., on Erythrina berteroana, Chimaltenango: S 80151; Retalhuleu: S 88716; Quezaltenango: S 83940. Otherwise known in the Americas only from Ecuador.

UREDO FICINA Juel, on Ficus aurea, Zacapa: K 5456; on F. involuta, Santa Rosa: S 79545; on F. padifolia, Retalhuleu: H 707; on F. sp., Retalhuleu: H 536; Suchitepéquez: H 527. This rust has commonly been considered to be synonymous with Cerotelium fici but because of distinctive morphological features should be treated separately.

UREDO FUCHSIAE see PUCCINIASTRUM FUCHSIAE.

UREDO IGNAVA Arth., on Arthrostylidium racemiflorum, Chimaltenango: J 1922; Guatemala: S 59210; on Bambusa vulgaris, El Petén: Lundell 2647A. First reported for Guatemala by Mains (36), based on Lundell's collection.

UREDO INCOMPOSITA Kern, on Eleocharis sp., Guatemala: K 5365, 5399. This species was recorded, in the N. Am. Flora, under the genus Dicaeoma. Should it prove to be a Puccinia the above specific name cannot be employed, since P. incomposita has has already been used by Jackson and Holway for a South American Baccharis rust.

UREDO INGAE P. Henn., on Inga edulis, Guatemala: H 486; Retalhuleu: H 719. For a recent discussion of this species and Bitzea ingae, previously united as Ravenelia ingae, see Mains (38).

UREDO MACHAERIICOLA Cumm., on Machaerium biovulatum, Retalhuleu: S 88557 (type). Known only from the type. For a description see Cummins (20).

UREDO MUEHLENBECKIAE Jacks. & Holw., on Muehlenbeckia tamnifolia, Quezaltenango: S 83551, 84321. Known otherwise from Bolivia and Ecuador. For a description see Jackson (26).

UREDO OBNIXA Cumm., on Cyperus melanostachyus, Huehuetenango: S 82692 (type). Known only from the type. For a description and discussion see Cummins (20).

UREDO ONCIDII P. Henn., on Oncidium cavendishianum. Found in a California greenhouse on plants imported from Guatemala.

UREDO PERIBEBUYENSIS Speg., on Polygala americana, Guatemala: H 682. Known also from Mexico and South America.

UREDO QUICHENSIS Cumm., on Calliandra conzattiana, El Quiché: S 81393 (type). Known only from the type. For a description see Cummins (20).

UREDO RONDELETIAE Arth. & Holw., on Rondeletia cordata, Guatemala: H 842 (type). Known only from the type.

UREDO RUBESCENS Arth., on Dorstenia contrajerva, Guatemala: H 634; Suchitepéquez: K 5374; Santa Rosa: S 78206; on D. houstoni, Retalhuleu: H 708; Suchitepéquez: H 520. Spores similar to those described by Kern, Ciferri and Thurston (34) for Uredo uncinata are present in some collections in intimate association with U. rubescens. The relationship is obscure.

UREDO TRINIOCHLOAE Arth. & Holw., on Triniochloa stipoides, Guatemala: H 59 (type). Known also from Colombia.

UREDO ZEUGITES Arth. & Holw., on Zeugites hartwegi, Guatemala: H 49 (type). Recorded also for Colombia.

UREDO sp., on Stelis sp., Alta Verapaz: S 91371. The collection is parasitized and not determinable. No rust has been recorded on Stelis.

UROMYCES AEGOPOGONIS see note under PUCCINIA AEGOPOGONIS.

UROMYCES ANTIGUANUS Cumm., on Desmodium orbiculare, Chimaltenango: S 80043, 80878; Huehuetenango: H 761, 764, S 82021; Sacatepéquez: H 583, J 76, 779, S 58900 (type), 61735, 63074. Known only from Guatemala. For a description see Cummins (15).

UROMYCES ASCLEPIADIS (Schw.) Cooke, on Asclepias curassavica, Guatemala: H 203; on A. guatemalensis, Guatemala: H 20. The species occurs in both North and South America.

UROMYCES BIDENTICOLA (P. Henn.) Arth., on Bidens heterophylla, Quezaltenango: H 747; on B. holwayi, Quezaltenango: H 816; on B. leucantha, Dept. unknown: Bernoulli & Cario; on B. pilosa, Alta Verapaz: S 90159, 92219; Chimaltenango: J 133, 134, 374, S 79759; Guatemala: Heyde & Lux, H 27; Jalapa S 77535, 77542; Sacatepéquez: J 75, S 58554; Solola: K 5429; on B. pilosa var. calcicola f. dissecta, Chimaltenango: J; on B. squarrosa, Chimaltenango: S 79850, 79953, 80218; Guatemala: H 4; Huehuetenango: S 82387; Jutiapa: S 77649; Quezaltenango: H 786, S 84298, 87106; Solola: H 110; on B. triplinervia, Chimaltenango: S 80820; Huehuetenango: S 81904; Quezaltenango: S 83248; on B. triplinervia var. mollis, Totonicapán: S 84051; on B. sp., Guatemala: K 5351. This species is widely distributed in tropical regions.

UROMYCES BIDENTIS Lagerh., on Bidens pilosa, Sacatepéquez: S 58043; on B. riparia, Sacatepéquez: J 386. Not previously recorded for Guatemala. Less frequent than P. bidenticola from which it differs in being microcyclic.

UROMYCES BONARIENSIS Speg., on Gomphrena tuerckheimii, Alta Verapaz: S 90193; Jutiapa: S 78482. Not previously reported for Guatemala and recorded for North America only from Nicaragua. Only uredia are present in North American collections.

UROMYCES BOUVARDIAE Syd., on Bouvardia leiantha, Guatemala: H 605; Santa Rosa: Heyde & Lux (type). Known also from Mexico. A variable species, especially as regards pedicels which are swollen in some collections and cylindric in others but basally rugose in all.

UROMYCES CALOPOGONII Cumm., on Calopogonium galactioides, Chimaltenango: J 165, S 79808 (type), 80947. Known only from Guatemala. For a description see Cummins (20).

UROMYCES CELOSIAE Diet. & Holw., on Iresine calea, Guatemala: K 4344, 5339, 5371, 5379, 5395; Sacatepequez: H 76, S 64282; Solola: H 128; on I. celosia, Chimaltenango: J 735; Huehuetenango: S 82913; Jalapa: S 77543. Known also from Costa Rica, Mexico, the West Indies, and South America.

UROMYCES CESTRI (Mont.) Lév., on Cestrum aurantiacum, Solola: H 143; on C. guatemalense, Totonicapán: S 84133. Not uncommon in tropical regions of the Americas. Uredia are not formed.

UROMYCES CLIGNYI Pat. & Har., on Andropogon hirtiflorus, Guatemala: H 57; Solola: H 114. Known also from Cuba, Mexico, and Africa.

UROMYCES COLOGANIAE Arth., on Cologania glabrior, Guatemala: H 31, 609. Known also from Mexico and Costa Rica.

UROMYCES COLUMBIANUS Mayor, on Melanthera aspera, Escuintla: H 507; Retalhuleu: H 711; Suchitepéquez: H 512, K 4610; on M. hastata, Izabal: H 602: Solola: H 672; on M. nivea, Chimaltenango: J 847, 865, S 80013; Huehuetenango: S 82993; Jalapa: S 77540. Difficult to distinguish, without telia, from Puccinia melantherae. Known from Florida southward into South America.

UROMYCES COMMELINAE (Speg.) Cooke, on Tradescantia cumanensis, Guatemala: H 683; Retalhuleu: H 710. Generally distributed in the warmer regions of the world.

UROMYCES CUCULLATUS Syd., on Baltimora recta, Jutiapa: S 75076; Santa Rosa: S 24063, 77895; on Perymenium grande, Alta Verapaz: S 69472; on P. purpusii, Quezaltenango: H 734; on P. strigillosum, Guatemala: H 679; Jalapa: K 7040; Sacatepéquez: H 541, K 5326, S 63171, 63867; on Zexmenia elegans var. kellermanii, Jutiapa: S 75006; on Z. scandens, Guatemala: H 43; Solola: H 183, 668. Reported from Mexico to Panama and in Cuba.

UROMYCES EPICAMPIS Diet. & Holw., on Epicampis macroura, Guatemala: H 26. Known otherwise from only single collections in Arizona, Ecuador, and Mexico.

UROMYCES ERAGROSTIDIS Tracy, on Eragrostis limbata, Chimaltenango: J 1700, S 79762; Sacatepéquez: H 651; Solola: H 167. Known from North and South America and Africa.

UROMYCES FABAE (Pers.) deB., on Vicia faba, Quezaltenango: H 796; San Marcos: S 86476. Widely distributed.

UROMYCES GEMMATUS B. & C., on Jacquemontia nodiflora, Jutiapa: S 75124. Not recorded previously for Guatemala. Known also from South America and the West Indies.

UROMYCES GOUANIAE Kern, on Gouania domingensis, Guatemala: K 5391 (type). Known only from the type.

UROMYCES GUATEMALENSIS Vesterg., on Bauhinia inermis, Escuintla: H 194; on B. pauletia, Jutiapa: S 75203, 75224; on B. ungulata, Retalhuleu: S 38556; on B. sp., Retalhuleu: Bernoulli & Cario (type). Known also from Costa Rica, El Salvador, and Venezuela.

UROMYCES HEDYSARI-PANICULATI (Schw.) Farl., on Desmodium angustifolium, Guatemala: H 589; on D. intortum, Chimaltenango: S 79767; on D. scorpiurum, Suchitepéquez: H 528, Maxon & Hay 3450; on

D. strobilaceum, Huehuetenango: S 82347; on D. tenuipes, Sacatepéquez: H 646; Solola: H 163; on D. sp., Guatemala: K 5323, Sacatepéquez: K 7196; Santa Rosa: S 77911. Common in the Americas.

UROMYCES HELLERIANUS Arth., on Cayaponia racemosa, Guatemala: K 5436; on Melothria guadalupensis, Alta Verapaz: S 92272; on M. scabra, Guatemala: H 630; on Cucurbitaceae undet., Guatemala: H 483, 862. Known from the West Indies, Central America, and Ecuador.

UROMYCES HYPERICI (Spreng.) Curt., on Hypericum pratense, Guatemala: H 25. Known from Canada to Chile.

UROMYCES ICTERICUS Cumm., on Iresine celosia, Chimaltenango: S 80214; Quezaltenango: H 803 (type), S 85473; Solola: H 141. Known only from Guatemala. This species was reported by Arthur (2, 5) as U. iresines, a South American rust. For a description and illustration see Cummins (16). Uredia are not formed.

UROMYCES ILLOTUS Arth. & Holw., on Mucuna andreana, Guatemala: H 487 (type). Known only from the type.

UROMYCES INDIGOFERAE Diet. & Holw., on Indigofera mucronata, Izabal: S 24568; Zacapa: K 5444. Known from Florida and Texas to Panama and in Venezuela.

UROMYCES IRESINES see UROMYCES ICTERICUS.

UROMYCES JUNCI-EFFUSI Syd., on Juncus effusus, Alta Verapaz: S 92266, 92534. Not previously recorded for Guatemala.

UROMYCES LEPTODERMUS Syd., on Panicum barbinode, Guatemala: H 12, K 5364; on P. maximum, Jalapa: S 77541; Sacatepéquez: S 64716. Thurston (47) reported notes concerning the characteristics of this species. For a recent description and discussion and for a photograph of teliospores see Cummins (19).

UROMYCES MACULANS (Pat.) Arth., on Cestrum lanatum, Guatemala: H 489. An infrequent species recorded otherwise from Bolivia, Costa Rica, and El Salvador. Uredia are not formed.

UROMYCES MEDICAGINIS Pass. see UROMYCES STRIATUS.

UROMYCES MONTANOAE Arth. & Holw., on Montanoa hibiscifolia, Chimaltenango: J 865a; Guatemala: K 5410; Retalhuleu: H 705; on M. pittieri, Guatemala: H 625: Sacatepéquez: H 77; Solola: H 176 (type); on M. pteripoda, Chimaltenango: J 1927a; on M. sp., Guatemala: K 5389. Recorded otherwise only from Costa Rica.

UROMYCES MONTANUS Arth., on Lupinus flabellaris, Quezaltenango: Steyermark 34169; Sacatepéquez: J 193, K 7447, S 65219; on L. montanus, Sacatepéquez: H 576. Described and otherwise known from Mexico.

UROMYCES MYRSINES Diet., on Ardisia paschalis, Jutiapa: J 1426. Not previously recorded for Guatemala. Known also from Costa Rica and South America. The species is microcyclic.

UROMYCES OAXACANUS Diet. & Holw., on Jatropha urens, Escuintla: J 773; Guatemala: H 2; Chimaltenango: J 1446; on J. tubulosa, Sacatepéquez: S 63847, 80975. Known otherwise from Arizona, British Honduras, and Mexico.

UROMYCES PHASEOLI (Pers.) Wint., on Phaseolus atropurpureus, Guatemala: H 202, K 5372; Jutiapa: S 75075; on P. lunatus, Solola: H 159; on P. macrolepis, Quezaltenango: S 83476; on P. vulgaris, Alta Verapaz: S 70971, 92179; Chimaltenango: S 79787; Jalapa: S 76497; on P. sp., Guatemala: Hitchcock, H 620; Huehuetenango: S 81310; Quezaltenango: H 105; Sacatepéquez: H 67; Santa Rosa: S 78910; Solola: H 117; Dept. unknown: Smyth. Widely distributed.

UROMYCES POLYMNIAE Diet. & Holw., on Polymnia maculata, Chimaltenango: S 80280; Guatemala: H 30, 62; Jalapa: K 7701; Quezaltenango: H 749; Retalhuleu: K 5447; Suchitepéquez: K 5305, 5387; Santa Rosa: S 78303; Solola: K 5384, 6310. Known also from Mexico and South America.

UROMYCES PRESSUS see MARAVALIA PRESSA.

UROMYCES PROEMINENS (DC.) Pass., on Euphorbia adenoptera, Izabal: K 7036; on E. brasiliensis, Guatemala: K 5341; Retalhuleu: H 533; on E. graminea, Santa Rosa: Deam 6137; on E. hirta, Chimaltenango: S 79753; Guatemala: H 477, K 5454; Quezaltenango: S 85799; Sacatepéquez: K 5328; Solola: H 142; on E. lasiocarpa, Guatemala: J 1429, K 5404; Jutiapa: S 75373; on E. thymifolia, Escuintla: S 89401. Widely distributed.

UROMYCES PUNCTATUS Schroet., on Astragalus guatemalensis, Quezaltenango: H 736, S 86067. Widely distributed.

UROMYCES SALMEAE Arth. & Holw., on Salmea scandens, Solola: H 188 (type). Known also from the Dominican Republic and Puerto Rico.

UROMYCES SCLERIAE P. Henn., on Scleria bracteata, Alta Verapaz: S 89700. This is the first Central American collection. Known also from the West Indies and South America.

UROMYCES SENECIONICOLA Arth., on Senecio acutangulus, Quezaltenango: S 84245. Not previously recorded for Guatemala. Known otherwise only from Mexico.

UROMYCES SOCIUS Arth. & Holw., on Struthanthus densiflorus, Huehuetenango: H 765; on S. quercicola (L. crassipes), Solola: H 169, 185; on S. sp., Sacatepéquez: H 539, 545 (type): Solola: H 665. Recorded only for Guatemala. For keys to the species of Uromyces on Loranthaceae see Cummins (11).

UROMYCES SOLANI Diet. & Holw., on Solanum appendiculatum, Chimaltenango: J 1911, S 80252; on S. nudum, Quezaltenango: H 315. Known also from Mexico and Colombia.

UROMYCES STRIATUS Schroet., on Medicago lupulina, Quezaltenango: S 66442; on M. sativa, Chimaltenango: S 79765; Sacatepéquez: J. Not previously reported for Guatemala. Widely distributed.

UROMYCES TRIFOLII (Hedw. f.) Lév., on Trifolium amabile, Guatemala: H 48; on T. sp., Totonicapán: J 507. Widely distributed.

UROPYXIS DALEAE (Diet. & Holw.) Magn., on Parosela diffusa, Guatemala: H 638; on P. domingensis, Guatemala: H 681; on P. nutans, Guatemala: H 612; Huehuetenango: S 81208. Reported also for Mexico, El Salvador, Bolivia, and Venezuela.

UROPYXIS DIPHYSAE (Arth.) Cumm., on Diphysa floribunda, Huehuetenango: S 82872; on D. rhobinioides, Guatemala: H 8; Retalhuleu:

H 716; Suchitepéquez: H 521; Solola: H 121a, 157; on D. sp., Escuintla: H 191, 195. Recorded otherwise from Costa Rica and Mexico. The species is microcyclic.

UROPYXIS HOLWAYI Arth., on Eysenhardtia adenostylis, Solola: H 161, 666. Known otherwise from Arizona and Mexico. The species is microcyclic.

UROPYXIS NISSOLIAE (Diet. & Holw.) Magn., on Nissolia fruticosa, Jutiapa: S 74895. Not previously reported for Guatemala. Known otherwise from El Salvador and Mexico.

URVILLEA ULMACEA H.B.K.: Puccinia arechavaletae.

VACHELLIA FARNESIANA (L.) W. & A.: Ravenelia siliquae.

VALERIANODES see STACHYTARPHETA.

VALOTA INSULARIS (L.) Chase: Puccinia atra.

VERBESINA AGRICOLARUM Standl. & Steyerm., APLEURA Blake: Coleosporium viguierae.

VERBESINA FRASERI Hemsl.: Coleosporium viguierae, Puccinia cognata.

VERBESINA GIGANTEA Jacq., GUATEMALENSIS Rob. & Greenm.: Coleosporium viguierae.

VERBESINA HOLWAYI Rob.: Coleosporium viguierae, Puccinia cognata.

VERBESINA HYPOGLAUCA Liebm. MYRIOCEPHALA Sch. Bip.: Coleosporium viguierae.

VERBESINA PERYMENIOIDES Sch. Bip.: Coleosporium viguierae, Puccinia abrupta.

VERBESINA PUNCTATA Rob. & Greenm.: Coleosporium viguierae, Puccinia abrupta, P. cognata.

VERBESINA SCABRIUSCULA Blake: Coleosporium viguierae.

VERBESINA STEYERMARKII Standl.: Puccinia irregularis.

VERBESINA SUBLOBATA Benth.: Coleosporium viguierae, Puccinia cognata.

VERBESINA TURBACENSIS H.B.K.: Coleosporium viguierae, Puccinia cognata, P. ferox.

VERNONIA ASCHENBORNIANA Schauer: Puccinia inaequata.

VERNONIA DEPPEANA Less.: Maravalia pressa, Puccinia discreta.

VERNONIA HEYDEANA Coult.: Puccinia idonea.

VERNONIA LEIOCARPA DC.: Puccinia notha, P. rata.

VERNONIA PATENS H.B.K.: Puccinia inaequata.

VERNONIA SCHEIDEANA Less.: Puccinia erratica.

VERNONIA SHANNONI Coult., STANDLEYI Blake: Puccinia notha.

VERNONIA TRIFLOSCULOSA H.B.K.: Puccinia idonea, P. praealta.

VERNONIA sp.: Puccinia insulana.

VIBURNUM DISCOLOR Benth.: Coleosporium viburni.

VICIA FABA L.: Uromyces fabae.

VIGNA REPENS (L.) Kuntze: Phakopsora vignae.

VINCETOXICUM sp.: Puccinia obliqua.

VIOLA NANNEI Polak., PRINGLEI Rose & House: Puccinia violae.

VITIS TILIAEFOLIA H. & B., VINIFERA L.: Phakopsora vitis.

WEDELIA ACAPULCENSIS H.B.K.: Puccinia inaudita, P. subaquila.

WEDELIA FILIPES Hemsl.: Puccinia inaudita, P. proba.

WISSADULA AMPLISSIMA (L.) Fr., PERIPLOCIFOLIA (L.) Presl: Puccinia heterospora.

XYLOPIA FRUTESCENS Aubl.: Dasyspora gregaria.

ZEA MAYS L.: Angiopsora zeae, Puccinia polysora, P. sorghi.
ZEUGITES HARTWEGII Fourn.: Uredo zeugitis.
ZEXMENIA ELEGANS Sch. Bip.: Puccinia inaudita, P. proba.
ZEXMENIA ELEGANS var. KELLERMANII Greenm.: Uromyces cucullatus.
ZEXMENIA FRUTESCENS (Mill.) Blake: Puccinia proba, P. zexmeniae.
ZEXMENIA LEUCACTIS Blake, LONGIPES Benth.: Puccinia inaudita.
ZEXMENIA SALVINII Hemsl.: Puccinia proba.
ZEXMENIA SCANDENS Hemsl.: Uromyces cucullatus.

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SUPPLEMENT 143

THE DECISIVE INFLUENCE OF LATE WINTER WEATHER ON WHEAT LEAF RUST EPIPHYTOTICS

December 1, 1943

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Division of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

THE DECISIVE INFLUENCE OF LATE WINTER WEATHER ON WHEAT LEAF RUST EPIPHYTOTICS

K. Starr Chester

Plant Disease Reporter
Supplement 143 December 1, 1943

On the basis of an analysis of winter and spring weather during 23 years of severe, moderate, and light wheat leaf rust (Puccinia triticina Eriks.) infection in Oklahoma (Pl. Dis. Rep. 26:213-217), the writer in 1942 suggested that leaf rust epiphytotics might be predicted by the end of March in Oklahoma, a time at which leaf rust is ordinarily inconspicuous, 2 1/2 months before harvest, in ample time to permit a modification of spring planting plans when a severe rust epiphytotic threatens. The basis for such prediction is an analysis of winter and March temperatures and precipitation, and disregards the weather of April, May, and June, the months during which leaf rust attack becomes apparent to the casual observer.

The purpose of this report is to present findings with reference to several cognate problems, viz. (1) application of the method of leaf rust prediction in the 1942 and 1943 seasons in Oklahoma, (2) suitability of the method for more northern parts of the United States, and (3) explanation of the significance of the December-March period and the non-significance of the April-June period in Oklahoma (or the counterparts of these periods in other latitudes) in terms of the annual cycle of leaf rust.

In the May 15, 1942 issue of the Plant Disease Reporter, on the basis of exceptionally dry weather from December through March, and despite a record-breaking April rainfall for Oklahoma of 8.31 inches, the writer predicted that 1942 would not be a year of severe leaf rust. That this opinion was not shared by other workers, who were impressed by the heavy April rainfall at the time the rust was appearing, is evidenced by a report from Kansas dated May 22 (Pl. Dis. Rep. 26:240) that "there is evidence that another severe epiphytotic of leaf rust of wheat is rapidly developing in the southern and central plains area." On June 15, however, the writer's prediction of a month before was borne out, when the Kansas report of that date stated that "the threatened leaf rust epiphytotic on winter wheat in Kansas failed to materialize, owing to unusually cold weather during May and early June." The fact that 1942 proved to be a light rust year in Kansas, Oklahoma, and Texas was well established by harvest time, but that this was due to cold weather in May and early June is not borne out by the facts. The official weather report for Kansas in 1942 indicates that the average temperature for May was 63.2°F. (comparing with the long-time average of 64.0°F.) and for June 72.7°F. (comparing with the long-time average of 73.8°F.). The temperatures were thus within about one degree of the normal temperatures for these months, and they could have been much lower without falling below the optimum range for wheat leaf rust multiplication (55-75°F.).

According to the late winter weather, 1943 was destined to be another year of slight leaf rust damage in Oklahoma (See Table 1). Despite a mild winter, the average temperature for March was 46.0°F., which is 4.6° below normal and well below the optimum for leaf rust multiplication. Moreover the total precipitation for January through March was only 2.72 inches, which is 54 percent of normal. There was nearly as much rain in April as in the three previous months combined, while May had a record-breaking 10.27 inches of rain. The 1943 season did prove to be a year of minor leaf rust damage. By harvest time wheat was conspicuously infected but the attack was too late to result in more than a trace of crop loss.

In both years, the fears of crop observers that failed to materialize were based on observation of weather conditions in April and May. All available evidence indicates that in the Southwest the conditions that determine the severity of leaf rust are those of December through March, and the 1942 and 1943 seasons both bear out the writer's hypothesis that in this latitude the weather from April onward will rarely, if ever, prevent an epiphytotic provided the late winter has been favorable, or permit an epiphytotic if the late winter has been unfavorable for rust. Reasons for this will be indicated presently.

It is of particular interest to determine whether the decisive influence of late winter weather on wheat leaf rust in the southern Great Plains has its counterpart in more northern parts of the wheat belt. _A priori_ one would not necessarily anticipate that this would be the case, since the annual cycle of leaf rust in the North occurs under conditions that vary somewhat from those in the Southwest. In the North there is less abundant over-wintering of the rust, owing to lower winter temperatures. Spring renewal of the rust is later, and is influenced to a greater extent than in the South by uredospores that are blown northward from the earlier infected fields of the South.

To investigate this point, the States of Illinois and Iowa were selected for comparison with Oklahoma, since they are sufficiently far to the north that their seasons are almost exactly one month later than that of Oklahoma, which simplifies comparison on the basis of average monthly temperatures, the month of March in Oklahoma corresponding phenologically to the month of April in Illinois and Iowa[1]. The principal years of severe leaf rust damage, and the principal years of very light leaf rust, according to reports in the Plant Disease Reporter, were selected for each State, excluding years of conflicting reports or of serious complication with stem rust. The pertinent weather data for late winter and spring in each of these years are tabulated in Table 1, the corresponding seasons being considered one month later in Iowa and Illinois than in Oklahoma. For Illinois the years 1922-1926 were included because particularly detailed data are available regarding the severity of leaf rust in Illinois during those years[2].

1/ Note in Table 1 that the long-time average temperature for March in Oklahoma differs by less than 2°F. from the long-time average temperature for April in Illinois and Iowa.

2/ Tehon, L. R. Epidemic diseases of grain crops in Illinois, 1922-1926. The measure of their prevalence and destructiveness and an interpretation of weather relations based on wheat leaf rust data. Ill. Nat. Hist. Surv. 17:1-96. 1927.

Considering first the years of severe rust, the average temperatures of late winter in all years for all States were normal or above normal, often considerably above. The average temperature for March in Oklahoma and April in Illinois and Iowa in all cases was normal or warmer than normal. For the period up to April 1 in Oklahoma and May 1 in Illinois and Iowa, in each of these years of severe rust the precipitation was normal or above normal. If now we turn to the spring months in which leaf rust becomes obvious, April and May in Oklahoma, and May and June in the more northern States, we find a striking lack of any correlation between temperature or precipitation and rust severity. In three of the years of severe rust in Oklahoma and in one year each in Illinois and Iowa, the spring period was abnormally dry, while in 4 other years of leaf rust epiphytotics the spring was abnormally wet. With one exception, 1935 in Illinois, the temperatures of these spring months were normal.

In regard to the years of light rust, abnormally low winter temperatures in 1936 in Illinois and Iowa were associated with poor rust development. In four additional cases the average temperature of March in Oklahoma or April in the North was clearly a limiting factor in rust development, these low average temperatures (43.2°F. to 46.9°F.) being well below the optimal range for leaf rust uredospore germination. Even more striking is the correlation between deficient precipitation in the late winter period and subsequent lack of rust intensity. In 14 out of the 17 years of light rust, the late winter period was characterized by a deficit in normal precipitation ranging from 73 percent to 20 percent. The three years of light rust with only minor moisture deficits in late winter were 3 of the 4 years with abnormally low temperatures in March (Oklahoma) or April (Illinois, Iowa). Hence, every year of light rust was a year characterized by deficient late winter moisture or abnormally low late winter temperatures or both, and no year of severe rust was so characterized. In the years of light rust, as in those of severe rust, there is again no correlation with either abnormal temperatures or abnormal precipitation during the spring months. Little rust occurred whether the April-May period in Oklahoma or the corresponding May-June period in Illinois and Iowa experienced 12.60 inches of rain (Oklahoma, 1943, a 55 percent excess) or 3.73 inches (Illinois, 1936, less than one-half normal) or any excess or deficit between these extremes. There were few departures from normal temperatures during the spring months of these years of light rust and even these were without significance since, both in the 14 normal years and the 3 years with temperature departures greater than 3.5°F., the average temperatures for the two spring months were within the range of optimal leaf rust development (55°-75°F.).

Consider now the mean temperature and moisture conditions for the years of severe rust in comparison with those of light rust for each State individually. It is seen that on the average the years of severe rust have average late winter temperatures up to 4.9° higher, and March (Oklahoma) or April (Illinois, Iowa) temperatures slightly higher than the years of light rust, and in particular the severe rust years have late winter precipitations that are almost or more than double those of the years of light rust. On the contrary, there is comparatively little difference in

	Years of Severe Rust						Years of Light Rust					
State	Year	Temp. Dec.-Feb.	Temp. Mar.	Temp. Apr.-May	Pptn. Jan.-Mar.	Pptn. Apr.-May	Year	Temp. Dec.-Feb.	Temp. Mar.	Temp. Apr.-May	Pptn. Jan.-Mar.	Pptn. Apr.-May
Oklahoma	1919	40.27	51.2	62.75	4.55	8.68	1924	40.17	43.2	61.90	4.96	6.65
	1921	45.53	57.0	64.55	6.64	5.80	1925	39.53	56.1	67.05	2.65	6.88
	1922	41.37	50.1	64.95	10.07	12.22	1936	36.13	56.3	66.10	1.33	5.48
	1927	42.37	50.7	67.65	6.30	9.01	1937	39.40	46.9	65.90	4.86	5.73
	1934	45.90	49.5	66.25	4.74	5.26	1940	37.33	53.0	64.05	3.44	8.90
	1935	42.90	57.40	61.75	6.24	9.76	1942	40.60	50.7	64.90	3.34	10.52
	1938	42.43	58.10	64.10	10.15	6.83	1943	42.2	46.0	65.6	2.72	12.60
	1939	41.77	54.1	65.65	6.28	6.20						
Mean		42.32	53.5	64.71	6.87	8.22		39.34	50.3	65.07	3.33	8.11
50-yr. av.		38.51	50.6	64.20	5.01	8.14		38.51	50.6	64.20	5.01	8.14
Mean:50-yr. average		+3.81°	+2.9°	+.51°	-37%	+1%		+.83°	-.4°	+.87°	-33%	-.3%
State	Year	Temp. Dec.-Mar.	Temp. Apr.	Temp. May-June	Pptn. Feb.-Apr.	Pptn. May-June	Year	Temp. Dec.-Mar.	Temp. Apr.	Temp. May-June	Pptn. Feb.-Apr.	Pptn. May-June
Illinois	1922	38.9	52.1	70.20	12.77	5.08	1924	28.6	54.0	63.45	6.36	10.35
	1923	34.4	60.9	67.05	8.77	7.88	1925	33.9	58.6	57.00	6.84	6.37
	1935	36.6	49.7	62.95	8.74	13.77	1926	32.0	46.4	66.55	8.12	6.39
	1938	36.3	54.4	66.80	11.13	10.37	1930	33.0	55.6	67.95	6.26	5.21
	1939	35.1	49.6	69.90	11.68	7.57	1934	33.2	53.3	73.45	5.02	4.09
							1936	27.6	49.0	70.10	6.02	3.73
Mean		36.3	53.3	67.38	10.62	8.93		31.4	52.8	68.08	6.44	6.02
50-yr. av.		31.6	52.2	67.10	8.61	8.15		31.6	52.2	67.10	8.61	8.15
Mean:50- yr. average		+4.7°	+1.1°	+.28°	+23%	+9.6%		-.2°	+.6°	+.98°	-25%	-26%
Iowa	1927	28.5	49.2	62.40	7.92	7.11	1931	31.5	50.9	66.25	4.23	6.69
	1929	23.0	51.2	62.65	7.38	5.55	1932	28.5	50.0	67.15	4.26	9.16
	1938	29.1	50.3	64.35	6.96	10.11	1933	28.2	48.8	69.15	4.63	6.00
							1936	19.3	45.9	68.15	3.46	5.76
Mean		26.9	50.2	63.13	7.42	7.59		26.9	48.9	67.68	4.15	6.90
50-yr. av.		24.9	48.7	64.90	6.54	8.69		24.9	48.7	64.90	6.54	8.69
Mean:50-yr. average		+2°	+1.5°	-1.77°	+13%	-13%		+2°	+.2°	+2.78°	-37%	-20%

the mean spring temperatures or precipitations between the years of severe rust and those of light rust for each state.

It was hoped to discover, in absolute terms of temperature and precipitation, the conditions favoring or inhibiting leaf rust development regardless of latitude. This has not been possible. For example epiphytotics occurred in Oklahoma when the January-March precipitation was 4.55 (1919) and 4.75 (1934) inches, values that for Oklahoma are not significantly subnormal, while in Illinois, where the normal precipitation for the same phenological period is much higher, years of light rust were associated with late winter precipitations of 5 to 7 inches, amounts that are significantly deficient for Illinois but would represent excessive late winter precipitation in Oklahoma. Iowa is intermediate in this respect.

The greater amounts of precipitation necessary to induce a leaf rust epiphytotic in Illinois are not due to higher average temperatures, which would readily dissipate the moisture. For corresponding phenologic periods the temperatures in Illinois and Oklahoma are very similar.

The more probable explanation of this apparent difference in effect on rust of the absolute levels of precipitation deficits among the three States is a psychological one. In Illinois, where the average winter and spring precipitation considerably exceeds that of Oklahoma, wheat leaf rust on the average can be expected to be more severe. Estimates of crop damage by diseases, as reported in the Plant Disease Reporter, are for the most part the estimates of men whose observations are confined to a single State. If a disease occurs in a given State, e.g. Illinois, with great regularity and causes a greater or less amount of damage almost every year, the disease would doubtless be considered "light" when it was actually much more destructive than the same severity of the disease would be considered in a State, e.g. Oklahoma, in which, due to different climatic conditions, the disease is normally less destructive. In other words, referring to Table 1, the amount of and damage from leaf rust in Oklahoma in 1927, a "severe" rust year for Oklahoma, associated with an excessive late winter rainfall for Oklahoma (6.30"), might be almost identical with the amount of and damage from leaf rust in Illinois in 1930, a "light" rust year for Illinois, associated with a deficient late winter rainfall for Illinois (6.26"). But since Oklahoma would record this as a "severe" rust year and Illinois would call it a "light" rust year, each term being correct for the confines and normal conditions of the State involved in each case, it becomes necessary to consider each State individually in interpreting leaf rust epiphytology. The principle that deficient warmth and precipitation in late winter inhibit rust applies equally in each of the States considered here, but the amount of precipitation that is considered deficient in one State may be excessive in another. An analogous case is the classification of American Upland

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Table 1. Average temperatures and total precipitation in Oklahoma, Illinois, and Iowa during the late winter and early spring in the principal years of severe and of light wheat leaf rust in each State. (Figures from U.S. Weather Bureau.) Precipitations underscored are 20% greater (dotted underscoring) or less (solid underscoring) than 50-year average. Temperatures underscored are 3 1/2°F. greater (dotted underscoring) or less (solid underscoring) than 50-year average.

cotton varieties as "susceptible" to angular leaf spot in the parts of the world where highly resistant Asiatic cottons are grown, while the Upland varieties are classed as "resistant" in areas where the very susceptible Sea Island varieties are cultivated.

It seems almost paradoxical that the weather at the time when leaf rust is readily apparent in wheat fields has little to do with its ensuant damage, while the weather at a period during which rust can be found only by long and patient search is dominant in influencing its subsequent destruction. Almost without exception, crop observers have attempted to correlate rust damage with the weather occurring after the rust has made its obvious appearance, and, as illustrated above in the discussion of the years 1942 and 1943 in the Southwest, in many cases these attempts have led to entirely erroneous conclusions. A striking example of this is seen in Tehon's study of wheat leaf rust in Illinois during the 5-year period 1922-1926[1/]. The three years of "destructive rust" were, respectively, years in which the May-June period (that period in which rust becomes apparent, and which, according to the foregoing analysis is immaterial in relation to rust development) was in one case dry and hot, in a second case wet and cold, and in the third case normal for temperature and precipitation. The two years in which rust was not destructive were years in which the rainfall was only very slightly below normal and the temperatures were normal during the May-June period. Tehon concludes that serious rust is associated with either dry-hot or wet-cold weather. Reference to Table 1, which includes those years for Illinois shows that this paradoxical situation is readily clarified by reference to the late winter weather, in which the years of light rust were years of deficient moisture or low temperatures in February-April.

The explanation of the decisive influence of late winter weather and the negligible influence of spring weather on leaf rust destructiveness can be found by examining the details of the annual cycle of the fungus and its environmental requirements.

Puccinia triticina (P. rubigo-vera var. tritici) overwinters as mycelium in winter wheat with occasional uredial multiplication during warm periods in the winter. Alternate hosts play no part in the overwintering of the leaf rust fungus in the United States. On the average, in late winter, one may expect to find leaf rust persisting to the extent of one uredinium per 10 to one per 1000 leaves, the amount being negatively correlated with the severity of the winter, resulting in winterkilling of the wheat leaves and hence of the fungus, and positively correlated with mild periods in the winter, which permit occasional rust multiplication, and winter precipitation which is essential to such multiplication, or which falls as a snow cover that protects infected leaves from destruction by freezing. The combination of these influences will determine the extent of overwintering whether to the extent of one pustule per 10 leaves or one per 10,000.

Rust ordinarily is not noticeable to the casual observer until it has reached the intensity of at least 1 pustule per leaf. This will be on the "first date of observation" which on the average is in early April in Oklahoma, and May or early June in the latitude of Illinois and

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[1/] l.c., fig. 101, p. 89, legend and pertinent discussion.

Indiana and slightly later in Iowa, i.e., at the end of the period of late winter weather that is essential to rust destructiveness. We may divide the course of spring renewal of leaf rust into two distinct phases: (1) the late winter phase, in which the rust increases from the least amount that overwinters (e.g. 1 pustule per 100, 1000, or 10,000 leaves) to the amount of rust that first becomes readily noticeable (approximately 1 pustule per leaf); and (2) the spring phase in which the rust increases from the first noticeable amount to its maximum for the season, which may be somewhat more than 1000 pustules per leaf. Each of these phases involves several successive generations of uredial multiplication, and it is important to note that rust multiplication proceeds as a logarithmic progression (x pustules $\rightarrow x^2$ pustules $\rightarrow x^3$ pustules $\rightarrow x^4$ pustules, etc.) in which the first generations of multiplication in late winter (e.g. from 1 pustule per 1000 leaves to 1 pustule per leaf) have fully the importance of the spring generations (e.g. from 1 pustule per leaf to 1000 pustules per leaf).

The late winter generations must occur in the presence of weather that is close to the lower thresholds for rust survival and reproduction. This is particularly noticeable in the last month of the late winter period, March in Oklahoma and April in Illinois and Iowa. During this month long-time average temperatures are from 48.7° to 52.2°F. in the 3 States. It is axiomatic that in growth and reproduction organisms respond most strikingly to minor variations in any environmental factor when the intensity of that factor is the least or most that can be borne without serious injury to the organism, i.e. when it is at a threshold level. A temperature of 50°F. is of such an intensity, for with a slight increase above 50°F. we reach the range of optimal leaf rust multiplication, while with a corresponding decrease below 50°F. the temperature becomes definitely unfavorable for leaf rust. Marshall Ward reported that the minimum temperature for satisfactory uredospore germination of P. triticina is 10°C. (= 50°F.). Moreover, several workers have noted with reference to the length of the incubation period of P. triticina that this period is about 7 days at optimal temperatures but that at lower temperatures it requires 10 to 12 days (Yarkina) or even 20 days in winter in India (Mehta). Thus temperatures even slightly below the averages for the last month of the late winter period are doubly inhibitory to leaf rust, and temperatures slightly above the average are doubly beneficial to it.

Similarly the precipitation of the late winter months is markedly less than that of the spring months in each of the States considered here. In addition the rust during the winter may be subjected to extremes of cold that in a single night may reduce the rust population by 9/10 or 99/100, thus necessitating additional generations of multiplication in order to reach the concentration it had before the freezing weather.

In all of these particulars we find that during the late-winter phase, the leaf rust organism lives a precarious existence in an environment in which slight departures from normal will turn the balance in the favor of or against the survival and increase of the rust. And since several generations of rust multiplication must occur in late winter if the disease is to reach epiphytotic proportions in the spring, it is

readily apparent why the late winter weather is decisive in influencing leaf rust epiphytotics.

Quite the reverse is the case in the spring months, April and May in Oklahoma and May and June in Illinois and Iowa. In the 33 years of severe and light rust indicated in Table 1, in no instance did the average temperature for the spring months lie outside the optimal range for leaf rust development. Furthermore, since these months are normally rainy months, we find that even in the seasons in which the spring rainfall drops below the long-time average, moisture still is plentiful, in comparison with the normal for the late winter months, and ample for leaf rust development in practically every year. Moreover, in the spring months, in contrast to the winter ones, leaf rust multiplication is not entirely dependent on repeated uredial generations in any given area of the Great Plains, since in the spring there are two sources of inoculum, uredospores produced locally and those that are brought in by the wind from more southern fields.

Thus the spring months, those in which rust becomes apparent, have little effect in deciding the destructiveness of leaf rust in any given year. The weather conditions in these months are regularly within the range favoring rust development, and hence we can understand the reason for the lack of correlation between spring weather and rust intensity that is evident from Table 1 and from the data of Tehon and those of the 1942 and 1943 seasons in the Southwest. The destructiveness of leaf rust appears to be a direct function of its intensity at the close of the late winter period (April 1 in Oklahoma, May 1 in Illinois and Iowa) and this intensity in turn depends on the extent to which the temperatures and precipitation of the late winter period have permitted winter survival and successive generations of multiplication up to the opening of the spring period. This situation is shown diagrammatically in Figure 1.

In the figure the critical late winter and non-critical spring periods are indicated. In the latter there is no variation in the slopes of the curves of rust intensity in accordance with the conclusion that rust multiplication proceeds fairly regularly during this period in virtually all seasons, since both moisture and temperatures are regularly within a broad optimal range. The intensity of ultimate rust development and the extent to which it causes crop loss, are direct results of the degree of infection on April 1 (for Oklahoma), which, as shown in the figure, depends first on the extent of reduction of infection due to winter killing (curves from December to March 1) and second on the extent to which March temperatures and precipitation are favorable. While the values for rust intensity and the slope of the curve of a "normal rust year" have been arbitrarily selected, they approximate the actual values and slope for Oklahoma. Thus in the "normal year" in Oklahoma one can find about 1 rust pustule per 10 leaves on March 1, which increases to about 1 pustule per leaf by April 1, and to about 1000 pustules per leaf just before maturity of the crop, producing a crop loss of 5 percent. In the epiphytotic year 1938 the rust was very conspicuous on April 2. The uppermost leaf reached the 1000-pustule stage at or shortly after heading of the wheat, and the crop loss was estimated at 29 percent.

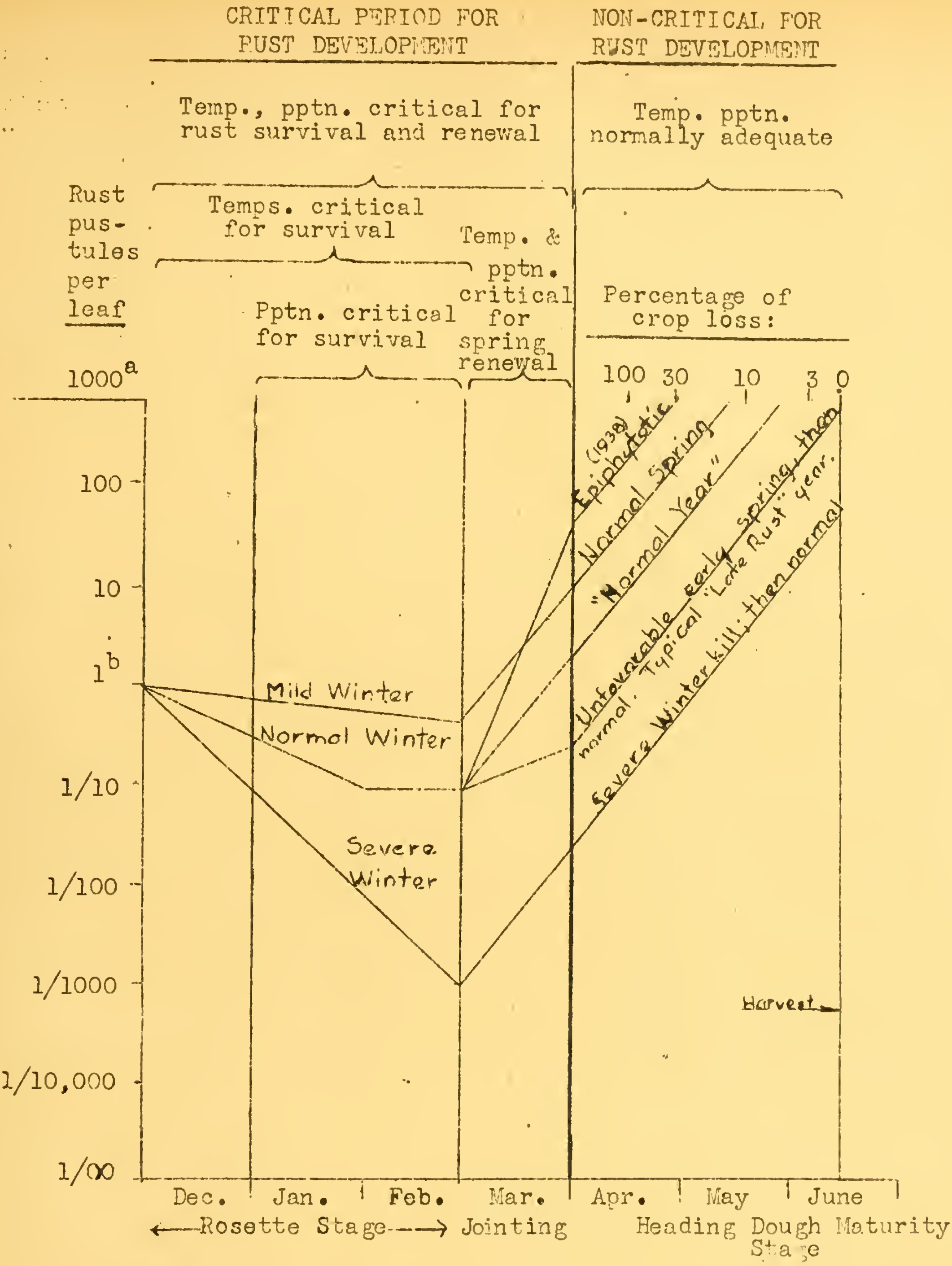

Figure 1. Diagrammatic representation of the effect of late winter weather in influencing the destructiveness of wheat leaf rust. Discussion in the text. Notes: a, 1000-pustule stage in which virtually all leaf tissue has been destroyed; in passing through fields one's clothes are reddened by the great quantities of uredospores; b, stage in which rust usually becomes noticeable to the casual observer.

The foregoing analysis is leads to the following practical considerations:

1. As pointed out previously (Pl. Dis. Rep. 26:213-217), assurance of an impending severe leaf rust epiphytotic 2 1/2 months before maturity of the wheat crop enables growers to modify cropping plans in time to avert serious losses from the disease. Under some circumstances it might prove advisable, in such a case, to harvest the crop as hay and recover the loss that would otherwise occur by using the land for corn, cotton, or summer legumes, since some such crop could be planted seasonably after the date on which it becomes evident that severe leaf rust losses are inevitable. While harvesting rusted wheat for hay may seem to be an extreme measure, such salvage of the crop is amply justified by the many cases on record in which leaf rust has resulted in harvest returns too small to pay for the harvesting and in which unharvested fields have been plowed under too late for either salvage as hay or planting of substitute crops.

Regarding the value of rusted wheat foliage as hay, there is convincing evidence that wheat foliage affected by leaf rust contains much more protein than normal wheat foliage. Bolley and Pritchard in 1906 (N. D. Agr. Exp. Sta. Bul. 68) cited Canadian tests that disclosed 7.65 percent protein in rusted plants as compared with 2.44 percent in healthy ones. In an extensive and careful series of determinations in Germany, Gassner and Franke in 1930 (Untersuchungen über den Stickstoffhaushalt rostinfizierte Getreideblätter. Phytopath. Zeitschr. 11:517-570.) found that 3 weeks after inoculation with leaf rust there was 21 times as much soluble nitrogen, 10 times as much protein nitrogen, and 16 times as much total nitrogen as in healthy plants. This proportionate increase in nitrogen with disease was not merely a relative increase (due to absolute decrease in other constituents of the plant) but included an absolute nitrogen increase as compared with healthy plants. For this reason the use of leaf-rusted hay as a superior source of protein deserves study in livestock feeding experiments. According to Eriksson and Henning, Bolley and Pritchard, and Arthur, rusted wheat hay is non-toxic to livestock and is eaten with great relish when properly cured.

2. It is well known that leaf rust can be combatted by dusting the crop with sulfur dust. This has great value in certain types of agronomic and phytopathological field experiments. In addition, recent tests of sulfur dusting of wheat by airplane have shown that under conditions of heavy rust infection, the sulfur treatment has more than paid for itself in increased yields. When the present military need for airplanes and pilots is ended, their services will be available to farmers in such peace-time pursuits as crop dusting. It is entirely possible that in the course of time, in localities and seasons of ample rainfall, when potential yields are high and the cost of the dust treatment represents a proportionately small part of the potential harvest value, sulfur dusting of cereals will become adopted as a standard agricultural practice.

Workers who have experimented with sulfur dusting for rust control have frequently noted that rust control and yield increases from dusting are not appreciable if the dust is not applied well before the disease becomes abundant. The foregoing analysis of the relation of late winter weather to leaf rust indicates the reason for this. According to this analysis the dust applications in late winter, when the crop is in the

rosette stage and leaf rust is present only in very small amounts, may be expected to have greatest rust-preventive effect, and this should be considered in experimental or practical cereal dusting. Not only is this the most important period for checking rust development, but it is also a period at which the cost of the chemical is lowest, since there is less foliage to be protected than later in the season.

3. In tests to determine varietal or strain resistance of wheat genotypes, in connection with breeding for leaf rust resistance or attempts to include such resistance in developing improved wheat varieties, it becomes necessary in dry seasons to resort to artificial watering in order to induce sufficient rust so that rust observations in the nursery are significant. Since adequate moisture in late winter has been found indispensable to severe leaf rust development, while the rainfall of the spring months is normally adequate for such development, it follows that the greatest effect of artificial watering in experimentally increasing the rust will be obtained in correcting late-winter water deficits, e.g. in February and March in the latitude of Oklahoma, rather than in attempting to remedy such deficits by applying water as the crop approaches maturity.

Summary

That the subsequent intensity and destructiveness of wheat leaf rust (Puccinia triticina Eriks.) is determined almost entirely by the temperatures and precipitation of late winter (December through March in Oklahoma; December through April in Illinois and Iowa), and that the weather of the two following spring months, those in which rust becomes obvious, has very little decisive effect on leaf rust development, is shown to be the case in 16 principal leaf rust years and 17 principal years of relative freedom from leaf rust in Oklahoma, Illinois, and Iowa. This also explains the apparently inconsistent relationship of spring weather to rust in the Southwest in 1942 and 1943 and in Illinois in 1922-1926. This seemingly paradoxical weather-rust relationship is due to the fact that leaf rust must increase from its lowest winter prevalence by a logarithmic series of uredinial generations. The first of these generations occur in late winter at a time when the absolute amount of rust is so small that it is not apparent to the casual observer. In this period temperatures and precipitation are so near the lower threshold permitting rust multiplication that minor deviations of weather turn the balance in favor of or against rust multiplication. This determines the prevalence of rust at the opening of spring, after which time weather deviations have little effect in accelerating or retarding the logarithmic increase of rust, since the norms of precipitation and temperature in the spring are so far within the optimal range for leaf rust reproduction that seasonal variations are not great enough to markedly alter the course of rust multiplication.

Practical considerations resulting from the foregoing analysis include: (1) use of rusted wheat, which contains more protein than normal wheat, as hay, with utilization of wheat land for a summer crop during years in

which epiphytotic leaf rust is indicated by the end of the late winter period; (2) attention to the importance of the late winter period in schedules for applying sulphur dust for experimental or practical rust control; and (3) importance of the late winter period in artificial watering to induce local leaf rust epiphytotics in wheat variety testing nurseries.

(OKLAHOMA AGRICULTURAL EXPERIMENT STATION)

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UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

I N S E C T P E S T S U R V E Y

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THE FIELD STATUS OF PARASITES OF THE EUROPEAN CORN BORER AT THE CLOSE OF THE 1942 SEASON

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INTRODUCTION

Collections of overwintering larvae of the European corn borer were made at the close of the 1942 season to determine the field status of parasites in localities where exotic species were known to be established or where recent releases had been made. The objective of this survey was to obtain basic information on establishment, dispersion, and increase of introduced parasites, and on other factors of value in planning and conducting a general program for colonization of corn borer parasites. The recoveries made from these collections, of the 22 species that have been imported and released since the inception of this activity in 1919, are summarized in table 1.

STATUS OF PARASITES

Vermont:

Very limited collections were made in six localities in Vermont to determine possible establishment of parasites from releases made during the period 1935 to 1938. No introduced parasites of the corn borer were recovered, therefore none are known to be established in the State of Vermont.

Middlesex, Mass.:

Locality surveyed: Three areas in Middlesex County, northwest of Boston, each covering 12 square miles, or a total of 36 square miles.

Parasitization of overwintering borers was only 4.5 percent, as determined by the rearings made. This is the lowest rate of parasitization recorded for this locality since 1927 and represents a further drastic reduction from the low of 7.7 percent recorded at the close of 1941. The parasite showing the greatest reduction was the ichneumonid _Inareolata punctoria_ Roman, which had parasitized only 3.5 percent of

the borers observed. Lydella grisescens R.D. was present in all three study areas, but had parasitized fewer than 1 percent of the hosts observed in any one area. A recovery of possible importance was two host specimens parasitized by the polyembryonic braconid Macrocentrus gifuensis Ashm. The recovery showed maintenance of this parasite here from the release of the species at Concord, Mass., in 1940.

Table 1.--Summary of European corn borer parasitization in various localities at the close of 1942

Locality	Area surveyed	Hosts observed	Parasitization by-- Lydella grisescens	Inareolata punctoria	Macrocentrus gifuensis	Chelonus annulipes	Eulophus viridulus	Total 1/
	Sq. mi.	Number	Percent	Percent	Percent	Percent	Percent	Percent
New England:								
Southeastern ----------	4,800	2,647	1.8	1.6	8.5	0 2/	0	11.9
Massachusetts:								
Middlesex County ------	36	1,813	.6	3.5	.1	0	0	4.2
Massachusetts and Connecticut:								
Southern Connecticut River Valley --------	2,825	2,929	1.7	5.9	.3	0.1	0	8.0
Vermont: ---------------	3/	689	0	0	- 4/	0	-	0
New Jersey:								
Burlington County -----	254	3,022	17.5	T 5/	T 5/	0	-	17.5
Monmouth County -------	154	1,539	3.9	1.7	2.7	0	-	8.3
Virginia:								
Accomac County --------	24	1,074	.6	0	0	0	-	.6
Princess Anne County --	7	520	21.3	0	0	0	-	21.3
Ohio:								
Erie County -----------	7	404	29.5	0	0	0	0.5	30.0
Lucas County ----------	12	590	24.6	0	0	0	1.5	26.1
Michigan:								
Monroe County ---------	7	290	28.3	0	0	0	0	28.3
Indiana:								
Tipton County ---------	6/	402	-	0	0	-	-	0
Illinois:								
Vermilion County ------	6/	395	-	0	0	-	-	0
Wisconsin:								
Sheboygan County ------	6/	144	0	0	0	-	-	0

1/ In addition, a few native parasites were collected from most of the localities.
2/ 0 - Release but no current recovery.
3/ Includes limited collections only from Chittenden, Grand Isle, Rutland, Washington, Windham, and Windsor Counties.
4/ - = No release in locality.
5/ T = Trace, less than 0.1 percent of parasitization.
6/ First releases in 1942; limited collections to determine initial establishment.

Southeastern New England:

Locality surveyed: The area enclosed by the northern boundary of the State of Massachusetts from the Atlantic coast west to Winchendon, then directly south through Brookfield and Sturbridge, Mass., to the Connecticut State line, thence east along the northern boundaries of Connecticut and Rhode Island to the city of Woonsocket, R. I., thence south through Kingston, R. I., to Long Island Sound, and along the coast back to the starting point, with the exception of the tip of Cape Cod above the town of Eastham. The total area within these boundaries is approximately 4,800 square miles. In this extensive area borer parasitization was found to average 12.0 percent. It varied considerably in different parts of the surveyed area, however, because of the uneven distribution of the exotic parasites.

Corn borer larvae collected from an area of 2,000 square miles in southeastern Massachusetts showed a parasitization of 19.7 percent. For comparison with the two previous years see table 2.

Table 2.--Parasitization of the European corn borer in southeastern Massachusetts at the close of the years of 1940-42

Year	Hosts observed	Parasitization by-- Lydella grisescens	Inareolata punctoria	Macrocentrus gifuensis	Chelonus annulipes	Total
	Number	Percent	Percent	Percent	Percent	Percent
1940	4,345	9.6	2.8	17.1	0.8	30.3
1941	1,932	6.0	1.2	8.4	.5	16.1
1942	1,291	2.8	.5	16.4	0	19.7

It will be seen that the exotic Macrocentrus gifuensis was the most important parasite and that an increase in its abundance is indicated by a borer parasitization of 16.4 percent in the fall of 1942, as compared with 8.4 percent at the close of 1941. Seventeen of the 56 collections had over 10 percent of the borers parasitized by this species and 12 of these showed a parasitization of over 20 percent. This species has also extended its range, having been recovered near the towns of Grafton and Uxbridge, in Worcester County, Mass. It had also crossed Narragansett Bay and was recovered near Wickford Junction, in southern Rhode Island.

A reduction in the effectiveness of Lydella grisescens, Inareolata punctoria, and Chelonus annulipes is indicated, continuing a trend evident for the last 3 years. Borer parasitization by the two first-named species in 1942 was only half what it was in 1941 and not a single specimen of the last-named species was recovered in 1942. It has been suggested that the reduction in effectiveness of these three parasites following the increase of Macrocentrus gifuensis may be a result of competition between parasites, but no data are available on this point.

Connecticut River Valley:

Locality surveyed: Because of the increased dispersion of two exotic parasites, Inareolata punctoria and Lydella grisescens, the area surveyed in the fall of 1942 was increased to cover 2,825 square miles. It consisted of a strip extending from Long Island Sound north through central Connecticut and south-central Massachusetts as far as the town of Sunderland, Mass., and extending out from 15 to 25 miles on each side of the Connecticut River. A total of 8.3 percent of the 2,929 borers observed from this extensive area were parasitized.

The introduced ichneumonid Inareolata punctoria was the most common parasite encountered. It was reared from 44, or two-thirds of the 66 collections made. Parasitization in individual collections ran as high as 30 percent, being highest within 15 miles of the point of first establishment and decreasing as the distance from the release point increased. I. punctoria was recovered from 3 of the 4 collections made near Milford, Conn., where releases of this species were made in 1934 and 1935. This represents a separate establishment of this parasite in that State, again confirming previous records.

The tachinid Lydella grisescens is widely distributed throughout the lower Connecticut River Valley, being present from Middletown, Conn., north to Amherst, Mass. Borer parasitization by this fly is low, however -- rarely above 10 percent in this area.

The egg-larval parasite Chelonus annulipes was recovered from three collections, near the town of Somers in Tolland County, near Windsorville, in East Windsor Township, Hartford County, and near Mount Carmel, in Hamden Township, New Haven County, Conn. This species shows no indications of increasing but still persists in the locality after establishment from extensive releases made in 1939.

The braconid Macrocentrus gifuensis was reared from four collections obtained in Connecticut--near Columbia, in Tolland County; at Marlboro, in Hartford County; at Portland, in Middlesex County; and at Milford, in New Haven County. The recovery of this parasite from the three first-named areas represents a second confirmation of its establishment, maintenance, and rapid dispersal from a release made at Haddam, Conn., in 1940. The recovery from Milford represents a first record for the species from that area where the parasite was released in 1940.

Atlantic Township, Monmouth County, N. J.:

Locality surveyed: A central circle 2 miles in diameter (section 1) with its center at the parasite release point 1 mile west of Colts Neck, in Atlantic Township, Monmouth County. The central circle was surrounded by three concentric rings (sections 2-9, 10-25, and 26-41), each 2 miles wide. Total area surveyed, 154 square miles.

The parasites reared from borers collected in the Atlantic Township (Colts Neck) locality at the end of 1942 were all introduced species. The most numerous and widely dispersed species was the tachinid Lydella grisescens, which was also the first exotic parasite of the borer released in the locality. Although it was still the leading parasite in the locality, the indications were that it was less effective in 1942, with an observed parasitization of only 3.9 percent of its hosts, than in 1941, when 8 to 10 percent of the hosts observed had been parasitized by it.

The ichneumonid Inareolata punctoria was less effective in 1942 than in 1941 in the central part of the surveyed area. In comparable collections made in the 2 years, parasitization of the borers observed dropped from 4.3 percent in 1941 to 1.4 percent in 1942. This was offset, however, by the known dispersal of the parasite into previously unoccupied territory. This solitary ichneumonid is not very effective as yet and the highest parasitization recorded to its credit in 1942 was only 11.8 percent.

The more recently introduced parasite, Macrocentrus gifuensis, continues to increase in numbers and disperse into new areas. In 1941 it was not found more than 3-1/2 miles from the release point. In 1942 it was reared from seven collections made approximately 4 miles and one collection made 6 miles from the point of release. Parasitization by M. gifuensis of borers in collections made in comparable territory during the 2 years was 1.3 percent in 1941 and 5.9 percent in 1942; however, the parasite is not yet abundant enough to show many high concentrations, although in one collection parasitization was 20.8 percent.

Burlington, N. J.:

Locality surveyed: A central circle 2 miles in diameter (section 1) with its center at the parasite-release point in Burlington Township, Burlington County. This central circle was surrounded by four concentric rings (sections 2-9, 10-25, 26-41, and 42-57), each 2 miles wide. Total area included, 254.5 square miles.

As in 1941, so also in 1942 only a single specimen of Inareolata punctoria was reared from the 3,022 host larvae observed from the Burlington locality. This specimen was reared from the hosts in collection No. 1, taken at the point of parasite release.

A single host larva parasitized by Macrocentrus gifuensis was also collected at the parasite-release point in Burlington Township. This species has been taken at this release point in previous surveys, but as yet shows no sign of increasing in abundance.

The parasite longest established in the Burlington locality is the tachinid Lydella grisescens. This parasite killed 17.5 percent of the hosts observed over the 254 square miles included in the surveyed area. Only 5 of the 57 collections made failed to produce this species and these 5 were made at the perimeter of the surveyed area. Twenty-one

collections showed a parasitization of over 20 percent by the tachinid and the collection at the parasite-release point in the heart of the surveyed area showed 58.6 percent of the borers killed by L. grisescens. Collections made within the central 78 miles showed 23.9 percent of the borers parasitized in 1942, as compared with 20.7 percent in a slightly smaller area surveyed at the close of 1941. The greatest increase in effectiveness of this parasite, however, took place in more outlying sections, which it had occupied at a later date.

Lee-Onley, Va.:

Locality surveyed: Evaluation study areas A and B, located in Accomac County on the "Eastern Shore" of Virginia. Each area is 3 to 4 miles in size. Area A is located 3 miles northeast of the town of Onley and area B is 3 miles southwest of this town. Total area surveyed, 24 square miles.

The only parasite reared from the 1,074 host larvae observed from the Lee-Onley, Va., locality was the fly Lydella grisescens, and only 6 specimens of this parasite were reared. It is evident that, although this parasite is still present in the locality, the parasitization of the borer to the extent of only 0.6 percent could not be of much importance.

Princess Anne, Va.:

Locality surveyed: A central circle (section 1) 1 mile in diameter with its center at the parasite-release point in Princess Anne County. This central circle was surrounded by a concentric ring (sections 2-9) 1 mile wide. Area surveyed, 7 square miles. Two supplementary collections, Nos. 10 and 11, were made 3 and 5 miles, respectively, from the parasite-liberation point.

Apparently only one species of corn borer parasite is established in Princess Anne County from releases made in 1941 at Back Bay. This parasite, Lydella grisescens, has not only become well established but has become abundant and is spreading rapidly. Because of the difficulty of associating parasite puparia found in the field with any one of the three overlapping generations of the host found in the locality, it is difficult to determine exactly what percentage of the borers in any generation are being killed by it. While collecting in the field, the author observed that about as many parasite puparia as host larvae were encountered, and the mortality of the corn borer larvae caused by these parasites must be very high. A total of 520 overwintering corn borer larvae were collected and from these 111, or 21.3 percent, were parasitized by L. grisescens. The parasitization of the borers collected at the parasite-release point (section 1) was 34.7 percent. The parasitization of all borers (413) collected within 1-1/2 miles of the release point (sections 1-9) was 24.9 percent, and the parasitization of borers collected 3 and 5 miles from the release point was 12.3 and 2.0 percent, respectively. The parasite has spread at least 5 miles since its release but has not yet increased enough to effect a high parasitization of the borer in the area more recently occupied by it.

Perkins, Erie County, Ohio:

Locality surveyed: A central circle (section 1) 1 mile in diameter with its center at the parasite-release point in Perkins Township, Erie County. The central circle was surrounded by a concentric ring (sections 2-9) 1 mile wide. Area surveyed, 7 square miles.

Two introduced parasites, Lydella grisescens and Eulophus viridulus Thoms., are established at the Perkins Township, Erie County, parasite-release point. The latter species is very scarce and only two host larvae parasitized by it were taken in the collections made. On the other hand, 29.5 percent of the corn borer larvae observed were killed by the tachinid. Borer mortality caused by this parasite was 61.2 percent for the hosts observed from the liberation point and 25.1 percent of those from the surrounding area.

Erie Township, Monroe County, Mich.:

Locality surveyed: A central circle (section 1) 1 mile in diameter with its center at the parasite-release point in Erie Township, Monroe County, Mich. The central circle was surrounded by a ring (sections 2-7) 1 mile wide. Area surveyed, 7 square miles.

The only exotic parasite reared from corn borer larvae collected in Erie Township at the close of 1942 was the tachinid Lydella grisescens. This fly had parasitized 34.1 percent of the host insects collected from the parasite-release point and 27.2 percent of the borers observed from the surrounding area. The average borer parasitization determined for the locality was 28.3 percent, and was credited to the introduced species. One specimen of an undetermined native parasite was reared from the borers collected.

Toledo, Ohio:

Locality surveyed: Area located close to the shore of Lake Erie east of Momeneetown and west of Bono, in Jerusalem Township, Lucas County. It covers 12 square miles, being 6 miles long and 2 miles wide, the long axis paralleling the lake front.

An average of 24.6 percent of the borers collected in this area were killed by Lydella grisescens. At the close of 1941 the percentage of observed borers parasitized by L. grisescens in the same area was 19.6 percent. Approximately 66.9 percent of the tachinid parasites noted had issued from their hosts before the collections were made. It is of interest to note that for the six collections made nearest the marshland bordering Lake Erie, parasitization by L. grisescens was 37.8 percent, while for the six collections made at an average of only 1 mile farther from the lake shore, parasitization of the observed borers was only 9.7 percent.

The exotic chalcid Eulophus viridulus was recovered from 6 of the 12 collections. An average of 1.5 percent of the borers were killed by it.

The Corn Belt:

Limited collections were made at three localities (Wildcat Township, Tipton, Ind.; Grant Township, Vermilion County, Ill.; and Wilson Township, Sheboygan County, Wis.) at the close of 1942 to check for possible initial establishment of parasites released the same season. The results were all negative, no introduced parasite being recovered from any of the three localities.

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
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INSECT PEST SURVEY

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STATUS OF THE EUROPEAN CORN BORER IN 1943

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Distribution

The known distribution of the European corn borer was extended

1/ The data presented in this report were accumulated by the Bureau of Entomology and Plant Quarantine and various interested State agencies, and were assembled and tabulated at Lafayette, Ind., substation of the laboratory for European corn borer research, Toledo, Ohio, with W. G. Bradley in charge. In addition to 119½ counties surveyed by the Bureau, the survey in 1943 was conducted in 78 counties of Indiana, by the Indiana State Conservation Department; in 14 counties of Maine, in 20 counties of New Jersey, in 28 counties of Pennsylvania, and in 8 counties of Vermont, by the State departments of agriculture of those States; in 15 counties of New York, including Long Island, by the New York Agricultural Experiment Station at Geneva and the New York State Department of Agriculture, cooperating; and in 7 counties of New Hampshire, in 32 counties of Illinois, in 11 counties of Iowa, in 4 counties of Missouri, and in half the 3 counties of Delaware, by the agricultural experiment stations of those States.

New county records of the European corn borer in 1943 were contributed by the State departments of agriculture of Minnesota, Missouri, North Carolina, Virginia, and Wisconsin; by the Kentucky Agricultural Experiment Station (which also provided similar information for 1942); by the State Conservation Department of Indiana; and by the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture. The Bureau appreciates the interest and cooperation of all States in which the survey was conducted and from which new records of distribution were obtained in 1943.

considerably westward and southward in 1943 in continuation of the noticeable spread of the insect in the previous 2 years. The following list gives the counties from which the European corn borer was reported in 1943 for the first time, and map 1 shows the known distribution of the insect to date, including the 1943 spread.

Indiana (2 counties): Vanderburgh and Warrick.

Iowa (38 counties): Allamakee, Appanoose, Benton, Black Hawk, Bremer, Buchanan, Butler, Cerro Gordo, Chickasaw, Clarke, Davis, Delaware, Fayette, Floyd, Franklin, Grundy, Hamilton, Hancock, Hardin, Howard, Iowa, Jasper, Lucas, Mahaska, Marion, Marshall, Mitchell, Monroe, Polk, Poweshiek, Story, Tama, Warren, Wayne, Winnebago, Winneshiek, Worth, and Wright.

Kentucky (35 counties): Allen, Anderson, Barren, Boyd, Breckinridge, Bullitt, Carter, Clark, Daviess, Estill, Fayette, Fleming, Franklin, Garrard, Grayson, Greenup, Hancock, Hardin, Harrison, Hart, Henderson, Larue, Madison, Marion, Meade, Nelson, Ohio, Scott, Shelby, Simpson, Spencer, Union, Warren, Washington, and Woodford.

Minnesota (1 county): Houston.

Missouri (13 counties): Adair, Cape Girardeau, Jefferson, Knox, Macon, Monroe, Perry, Putnam, Randolph, Ste. Genevieve, Schuyler, Scotland, and Shelby.

North Carolina (4 counties): Beaufort, Hyde, Perquimans, and Washington.

Virginia (8 counties): Clarke, Culpeper, Frederick, Hanover, King William, Rappahannock, Shenandoah, and Warren.

Wisconsin (21 counties): Adams, Barron, Buffalo, Chippewa, Clark, Crawford, Eau Claire, Jackson, Juneau, La Crosse, Lincoln, Monroe, Pepin, Pierce, Polk, Richland, Rusk, Taylor, Trempealeau, Vernon, and Wood.

Fall Abundance

Again, in the fall of 1943, the abundance of the European corn borer in corn was determined for a considerable part of the infested area. In all, 3,568 cornfields were examined in 337 counties in 20 infested States. Except in Delaware and Maine, the survey procedure in 1943 followed that in general use by the Bureau during recent years. By this method 10 cornfields at random were sampled within each county, the count of infestation being obtained by examining 25 consecutive corn plants taken at a given distance within a field from near the mid point

of its most accessible edge, and the number of borers per infested plant being determined by dissecting the first 2 plants found infested. The procedure in Delaware differed only to the extent of doubling the number of fields examined per county. In Maine 25 to 30 fields were surveyed in each county, the population figure for each field being based on an examination of 100 plants and the dissection of 5 infested plants. In either survey procedure the product of the percentage of plant infestation in a field and the average number of borers per infested plant provided a figure designated as the average number of borers per 100 plants. The population data derived in this way for the individual fields were then grouped in the calculation of county averages.

A summary of the data on borer abundance in corn for all counties and States surveyed in 1943 is presented in table 1, in which the results of the 1942 survey are also given for comparison. In table 2 the average numbers of borers per 100 plants are given for each county surveyed in 1943 and all possible comparisons are made with similar data for 1942. It should be noted that a zero recorded in table 2 for any county indicates a population so low that no infested plants occurred within the specified counts and does not necessarily mean the complete absence of the borer. The relative abundance of the borer in corn in that part of the infested area surveyed in 1943 is shown on map 2.

The general level of European corn borer abundance in 1943 was the highest on record in the United States, and the insect was present over a much greater area than in any previous year. The average number of borers per 100 plants for 267 comparable counties in the survey was 176.3 in 1943 as compared with 96.1 in 1942. Significant increases in corn borer abundance from 1942 to 1943 occurred in 18 of the 20 infested States in which the current fall survey was conducted. The two exceptions to the increase were New Hampshire and Vermont, where relatively light populations remained about the same in 1943 as in 1942.

The more notable infestations of the borer in the fall of 1943 were found in southern New England, on Long Island and in the Hudson River Valley of New York; in central New Jersey, southeastern Pennsylvania, and Delaware, on the Eastern Shore of Maryland and Virginia, in the northeastern corner of North Carolina, in southwestern Ohio, in the northern two-thirds of Indiana, and in northwestern Illinois. Maximum concentrations of the insect (i.e., populations of more than 601 borers per 100 plants) occurred on Long Island, N. Y., in Bucks, Delaware, Montgomery, and Chester Counties, Pa., in New Haven and Hartford Counties, Conn., in Mercer County, N. J., in Worcester County, Md., in Northampton County, Va., and in Newton County, Ind.

The first generation of the corn borer was not specially injurious to field corn in the Corn Belt States in 1943. In general, corn was planted late owing to exceptionally wet weather, and as a result there probably occurred (1) a diversion of many ovipositing moths from the short corn available to other host plants which were more attractive to them at the time of oviposition and (2) a lowered survival of the larvae hatching from the eggs which were deposited on the young corn. The second generation of the insect, however, apparently encountered

favorable conditions and developed in greater numbers in corn during the fall of 1943 than in the previous fall, causing some plant breakage.

Summer Abundance in Sweet Corn and Other Plants 2/

Reports from various parts of the infested area indicated a generally heavy infestation of the European corn borer in early market sweet corn in 1943, both in commercial plantings and in Victory gardens. A small number of fields of sweet corn were surveyed in each of several localities, and the data on borer abundance obtained are summarized in table 3. As a rule, the fields surveyed represented the most heavily infested ones within a given locality. In a number of localities the acreage planted to early sweet corn was much reduced in 1943 as a result of serious borer damage in 1942.

In the vicinity of New Haven, Conn., an average of 9.5 borers per plant was found in early sweet corn in 1943 as compared with 7.9 in 1942, the infestation in the 6 highest fields ranging from 10.1 to 22.1 larvae per plant. Borer abundance in sweet corn in the Beverly district in New Jersey increased from an average of 4 borers per plant in 1942 to 9.9 in 1943. Eight, or 40 percent, of the fields surveyed in this locality in 1943 averaged from 12.3 to 17.7 larvae per plant. Little early sweet corn was grown in the area immediately west of Toledo, Ohio, in 1943, and the 6 fields surveyed in that locality were ruined by the borer. The number of borers per plant in these fields in 1943 averaged 36.3 as compared with 8.5 for the same general locality in 1942, and the per-plant populations of the borer in the individual fields were as follows: 55.7, 35.8, 32.6, 31, and 29.9. Similar destruction of early sweet corn occurred in the small acreage grown in Kankakee County, Ill., in 1943. Four fields near St. Anne in that county averaged 38.3 larvae per plant, the per-plant populations of the borer in the individual fields being as follows: 53.8, 44, 32.4, and 23. Severe economic damage to sweet corn by the corn borer was also reported from Pennsylvania, New York, and Massachusetts. Sweet corn grown east of St. Louis, in Madison County, Ill., was very lightly infested in 1943.

The European corn borer was abundant in many fields of oats in Ohio, Indiana, and Illinois, in 1943, and caused considerable breakage of the plant stems. The borer also caused economic damage to some commercial plantings of gladiolus in Illinois and Indiana, and the insect was common in white potato plants in New Jersey, Pennsylvania, New York, Virginia, and Connecticut, and occasionally present in this crop in Ohio, Indiana, and Illinois.

2/ Information on the borer in sweet corn and in other plants was kindly supplied by the entomologists of the agricultural experiment stations of Maine, New Jersey, New York (Geneva and Ithaca), Massachusetts, Ohio, Indiana (Purdue), and Illinois, and of the State departments of agriculture of Pennsylvania, Virginia, and Rhode Island.

In addition, the borer was recorded as infesting the following plants in 1943: Tomatoes (fruit and plant), peppers, rhubarb, cabbage, beans, peas, beets, soybeans, lima beans, swiss chard, hemp, onion plants, zinnia, marigold, and other flowering plants in gardens, and various weeds, including smartweed, ragweed, and wild mustard. In some instances the infestation was undoubtedly due to migration of the borers from nearby sweet corn or oats.

Table 1.--Summary by States of European corn borer abundance in corn, fall of 1943, and comparisons with data for 1942

State	1943		Comparable counties, 1943 with 1942	Average borers per 100 plants	
	Counties	Average borers per 100 plants		1942	1943
	Number	Number	Number	Number	Number
Connecticut	6	563.8	6	79.0	563.8
Delaware	3	244.7	3	106.1	244.7
Illinois	41	65.1	24	64.5	90.5
Indiana	78	170.8	78	156.4	170.8
Iowa	20	19.9	0	-	-
Maine	14	12.0	13	3.6	11.8
Maryland	8	210.7	8	53.0	210.7
Massachusetts	6	320.8	6	21.7	320.8
Michigan	14	66.0	14	38.2	66.0
Missouri	8	2.2	0	-	-
New Hampshire	9	11.4	9	12.2	11.4
New Jersey	19	246.7	19	125.3	246.7
New York	21	210.5	19	127.6	232.1
North Carolina	3	259.0	3	61.2	259.0
Ohio	33	119.7	21	74.9	110.8
Pennsylvania	28	251.7	18	96.2	367.6
Rhode Island	2	398.3	2	79.3	398.3
Vermont	10	24.9	10	21.9	24.9
Virginia	5	449.8	5	189.2	449.8
Wisconsin	9	61.6	9	27.5	61.6
Total	337	-	267	-	-
Areal average	-	148.6	-	96.1	176.3

able 2.--European corn borer abundance in corn, fall of 1943, and comparisons with data for 1942

State and county	Average borers per 100 plants 1942	Average borers per 100 plants 1943	State and county	Average borers per 100 plants 1942	Average borers per 100 plants 1943
	Number	Number		Number	Number
onnecticut:			Illinois (Cont'd)		
Hartford	106.4	970.8	Mercer	-	61.2
Middlesex	105.6	484.4	Ogle	16.4	215.8
New Haven	145.4	979.2	Peoria	16.4	90.0
New London	81.2	502.8	Rock Island	5.8	93.6
Tolland	22.6	207.8	Sangamon	7.0	13.6
Windham	12.8	237.6	Scott	-	13.8
Average:			St. Clair	-	1.6
6 counties	79.0	563.8	Stephenson	-	136.6
			Vermilion	162.2	97.6
elaware:			Whiteside	10.4	216.4
Kent	43.9	248.0	Will	-	89.2
New Castle	117.2	360.3	Woodford	50.0	151.8
Sussex	157.3	125.9	Average:		
Average:			24 counties	64.5	90.5
3 counties	106.1	244.7	41 counties	-	65.1
llinois:			Indiana:		
Adams	-	0.8	Adams	171.2	116.4
Boone	3.2	104.8	Allen	174.6	128.2
Bond	-	0	Bartholomew	114.4	31.0
Bureau	7.2	169.4	Benton	302.5	371.8
Champaign	143.0	31.6	Blackford	501.7	302.4
Christian	5.4	15.6	Boone	135.0	130.4
Clark	-	62.2	Brown	42.6	27.6
Crawford	18.2	16.2	Carroll	295.4	229.8
DeKalb	41.0	67.8	Cass	375.2	197.0
DuPage	-	64.8	Clay	93.4	19.8
Edgar	40.6	30.4	Clinton	248.8	143.6
Fayette	-	0.8	Daviess	2.1	25.4
Grundy	193.6	58.0	Dearborn	46.2	47.2
Hancock	-	2.4	Decatur	70.0	48.2
Henderson	-	28.0	Dekalb	94.3	184.2
Henry	6.4	74.6	Delaware	412.1	151.6
Iroquois	293.8	215.8	Elkhart	68.7	312.6
Jefferson	-	0	Fayette	280.6	175.4
Jersey	-	4.2	Fountain	268.3	144.0
Kankakee	240.8	88.6	Franklin	90.0	52.4
Lake	11.8	25.4	Fulton	281.2	541.4
La Salle	36.4	132.2	Gibson	1.5	8.2
Lawrence	-	12.4	Grant	488.9	216.2
Livingston	123.0	79.0	Greene	16.3	49.6
Logan	26.0	59.0	Hamilton	196.2	125.8
Macon	24.2	35.8	Hancock	223.3	144.8
Madison	-	1.6	Hendricks	87.7	79.4
McDonough	-	20.4	Henry	339.5	191.4
McLean	64.6	87.8			

Table 2.--European corn borer abundance in corn, fall of 1943, and comparisons with data for 1942--Continued

State and county	Average borers per 100 plants 1942	1943	State and county	Average borers per 100 plants 1942	1943
	Number	Number		Number	Number
Indiana (Cont'd)			Indiana (Cont'd)		
Howard	303.2	311.6	Warrick	0	11.4
Huntington	156.8	267.4	Warren	201.7	309.0
Jasper	224.6	526.0	Wayne	401.6	176.2
Jay	252.4	215.0	Wells	302.3	320.6
Jefferson	5.9	28.4	White	198.9	438.0
Johnson	234.2	215.6	Whitley	47.8	253.6
Knox	5.3	17.2	Average:		
Kosciusko	184.5	332.0	78 counties	156.4	170.8
Lagrange	13.4	173.8			
Lake	34.0	293.8	Iowa:		
La Porte	71.4	155.2	Cedar	-	12.4
Madison	243.3	179.4	Clayton	-	1.2
Marion	220.7	183.6	Clinton	-	114.0
Marshall	117.4	215.4	Delaware	-	3.6
Miami	292.1	337.8	Des Moines	-	11.6
Montgomery	114.2	102.4	Dubuque	-	9.0
Morgan	84.3	112.8	Henry	-	9.8
Newton	259.0	684.2	Jackson	-	53.8
Noble	32.5	255.8	Jefferson	-	2.4
Ohio	39.5	47.0	Johnson	-	9.2
Owen	10.7	16.6	Jones	-	13.6
Parke	97.9	124.0	Keokuk	-	3.2
Pike	0	8.4	Lee	-	5.2
Porter	32.6	273.6	Linn	-	7.2
Posey	1.0	2.8	Louisa	-	5.2
Pulaski	120.1	216.8	Muscatine	-	23.6
Putnam	98.2	62.8	Scott	-	98.2
Randolph	364.8	153.2	Van Buren	-	0.4
Ripley	20.9	15.8	Wapello	-	3.6
Rush	205.2	129.4	Washington	-	10.6
St. Joseph	103.2	271.6	Average:		
Shelby	203.5	127.2	20 counties	-	19.9
Spencer	0.3	4.0			
Starke	139.1	273.2	Maine:		
Steuben	55.7	202.6	Androscoggin	2.7	15.7
Sullivan	12.5	47.2	Cumberland	6.2	7.0
Switzerland	32.4	24.6	Franklin	2.0	4.5
Tippecanoe	340.4	212.8	Hancock	0.7	16.9
Tipton	283.4	382.6	Kennebec	2.1	5.7
Union	195.6	74.2	Knox	4.0	21.8
Vanderburgh	0	1.2	Lincoln	1.8	4.9
Vermillion	161.8	140.6	Oxford	1.0	4.6
Vigo	54.1	46.0	Penobscot	-	15.2
Wabash	203.9	152.6	Piscataquis	0.6	13.0

Table 2.--European corn borer abundance in corn, fall of 1943, and comparisons with data for 1942--Continued

State and county	Average borers per 100 plants 1942	1943
	Number	Number
Maine (Cont'd)		
Sagadahoc	10.4	16.5
Somerset	2.0	25.7
Waldo	1.5	8.7
York	11.2	8.1
Average:		
13 counties	3.6	11.8
14 counties	-	12.0
Maryland:		
Caroline	39.0	79.4
Dordhester	17.4	116.0
Kent	43.4	212.4
Queen Annes	36.8	75.6
Somerset	13.8	102.6
Talbot	47.6	185.6
Wicomico	91.8	175.4
Worcester	134.0	738.4
Average:		
8 counties	53.0	210.7
Massachusetts:		
Essex	39.6	333.8
Franklin	3.2	110.2
Hampden	60.4	374.4
Hampshire	17.2	345.4
Middlesex	6.4	512.8
Worcester	3.5	248.2
Average:		
6 counties	21.7	320.8
Michigan:		
Allegan	4.2	84.8
Berrien	18.4	90.8
Gratiot	12.4	123.0
Huron	66.8	30.8
Lenawee	42.8	154.0
Macomb	21.8	79.2
Monroe	94.2	97.2
Ottawa	3.2	49.2
Saginaw	25.6	18.0
St. Clair	27.4	21.2
Sanilac	19.2	12.8
Tuscola	74.2	99.8
Michigan (Cont'd)		
Van Buren	12.8	17.6
Wayne	112.4	45.8
Average:		
14 counties	38.2	66.0
Missouri:		
Clark	-	2.8
Lewis	-	8.8
Lincoln	-	0
Marion	-	3.2
Pike	-	0
Ralls	-	1.2
St. Charles	-	0
St. Louis	-	1.2
Average:		
8 counties	-	2.2
New Hampshire:		
Belknap	5.6	8.8
Carroll	2.0	3.0
Cheshire	47.2	17.4
Grafton	5.8	18.2
Hillsboro	3.6	7.2
Merrimack	7.2	9.8
Rockingham	7.6	23.8
Strafford	2.0	8.0
Sullivan	28.6	6.4
Average:		
9 counties	12.2	11.4
New Jersey:		
Atlantic	23.6	17.8
Bergen	190.6	471.2
Burlington	273.4	395.8
Camden	182.7	212.5
Cape May	21.6	35.0
Cumberland	99.0	187.1
Essex-Union	75.8	359.0
Gloucester	95.8	124.8
Hunterdon	87.0	205.6
Mercer	166.4	762.4
Middlesex	437.0	459.4
Monmouth	273.8	391.6

Table 2.--European corn borer abundance in corn, fall of 1943, and comparisons with data for 1942--Continued

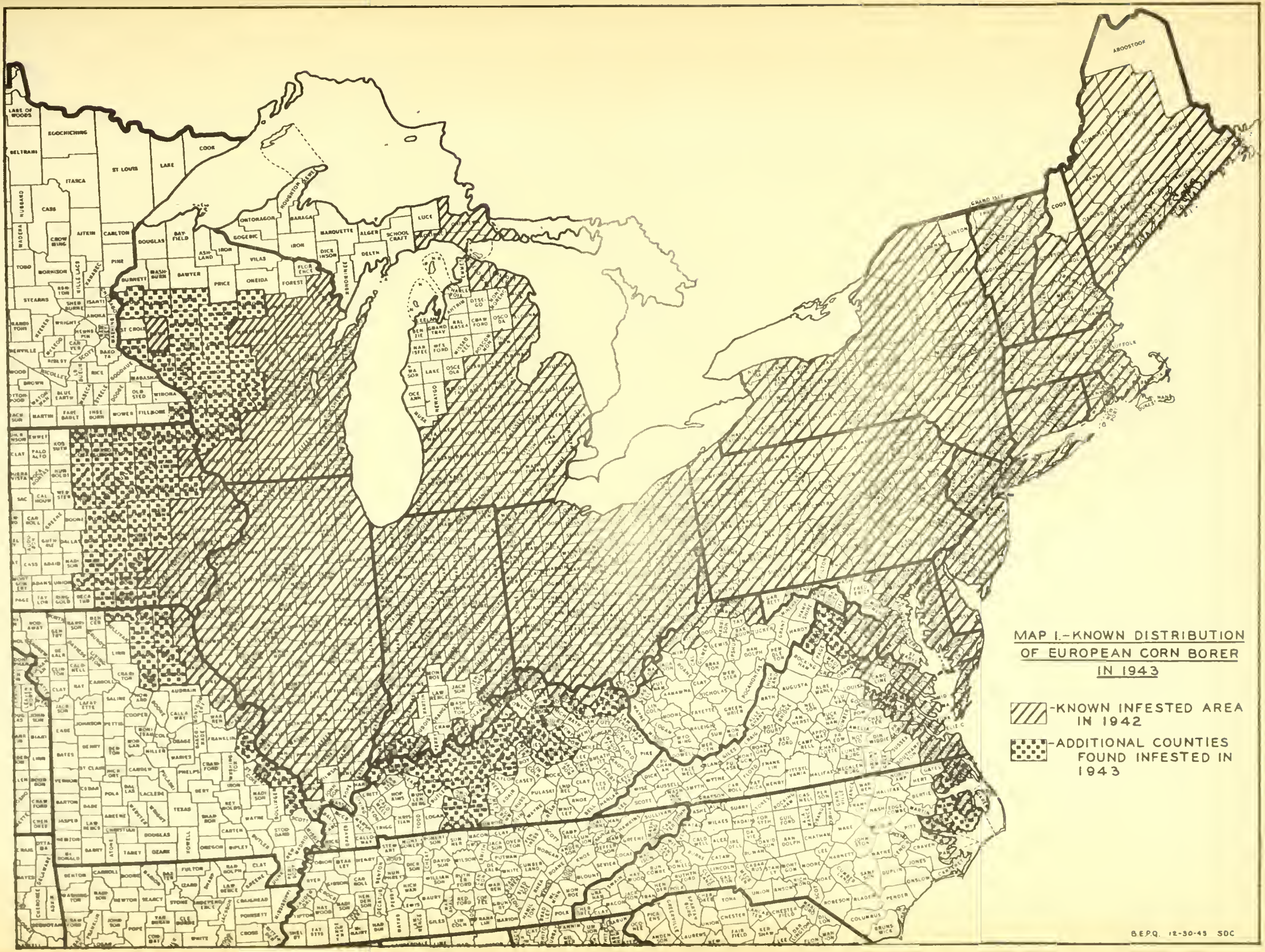
State and county	Average borers per 100 plants 1942	Average borers per 100 plants 1943
	Number	Number
New Jersey (Cont'd)		
Morris	40.8	270.0
Ocean	68.7	136.3
Passaic	154.2	163.2
Salem	29.4	121.4
Somerset	112.4	178.6
Sussex	17.2	81.6
Warren	32.0	114.4
Average:		
20 counties	125.3	246.7
New York:		
Albany	43.0	382.0
Broome	-	0
Columbia	54.8	195.2
Dutchess	72.4	143.0
Erie	30.4	51.0
Greene	15.0	120.2
Livingston	5.2	3.6
Monroe	80.4	8.2
Nassau	473.6	1782.0
Niagara	518.2	104.2
Oneida	11.8	2.6
Onondaga	52.8	43.4
Ontario	-	11.4
Orange	101.6	132.4
Orleans	30.6	41.0
Rensselaer	12.2	70.0
Saratoga	14.8	179.6
Schenectady	38.0	124.2
Suffolk	576.6	753.6
Ulster	172.4	256.2
Wayne	120.8	16.6
Average:		
19 counties	127.6	232.1
21 counties	-	210.5
North Carolina:		
Camden	127.6	121.4
Currituck	33.8	531.2
Pasquotank	22.2	124.4
Average:		
3 counties	61.2	259.0
Ohio:		
Allen	61.6	113.8
Auglaize	42.6	96.8
Ohio (Cont'd)		
Butler	-	136.6
Champaign	38.0	248.2
Clark	-	178.0
Clinton	-	95.0
Darke	-	70.8
Defiance	50.6	50.8
Fayette	22.2	104.2
Franklin	-	196.0
Fulton	108.0	54.2
Greene	-	146.2
Hamilton	-	77.4
Hancock	110.4	95.8
Hardin	29.0	119.6
Henry	126.2	144.2
Logan	57.0	111.8
Lucas	98.2	85.6
Madison	-	270.4
Mercer	9.4	112.6
Miami	15.2	305.4
Montgomery	-	112.8
Ottawa	24.6	37.2
Paulding	142.0	30.8
Pickaway	-	144.4
Preble	-	85.2
Putnam	183.6	90.2
Sandusky	56.4	159.2
Shelby	11.6	104.6
Van Wert	207.2	125.2
Warren	-	109.8
Williams	52.0	32.6
Wood	126.2	104.8
Average:		
21 counties	74.9	110.8
33 counties	-	119.7
Pennsylvania:		
Adams	-	66.2
Armstrong	11.6	5.6
Berks	31.0	418.8
Bucks	433.2	1364.4
Butler	-	8.0
Centre	8.2	26.2
Chester	68.6	936.2
Crawford	4.2	56.6
Cumberland	2.0	58.0

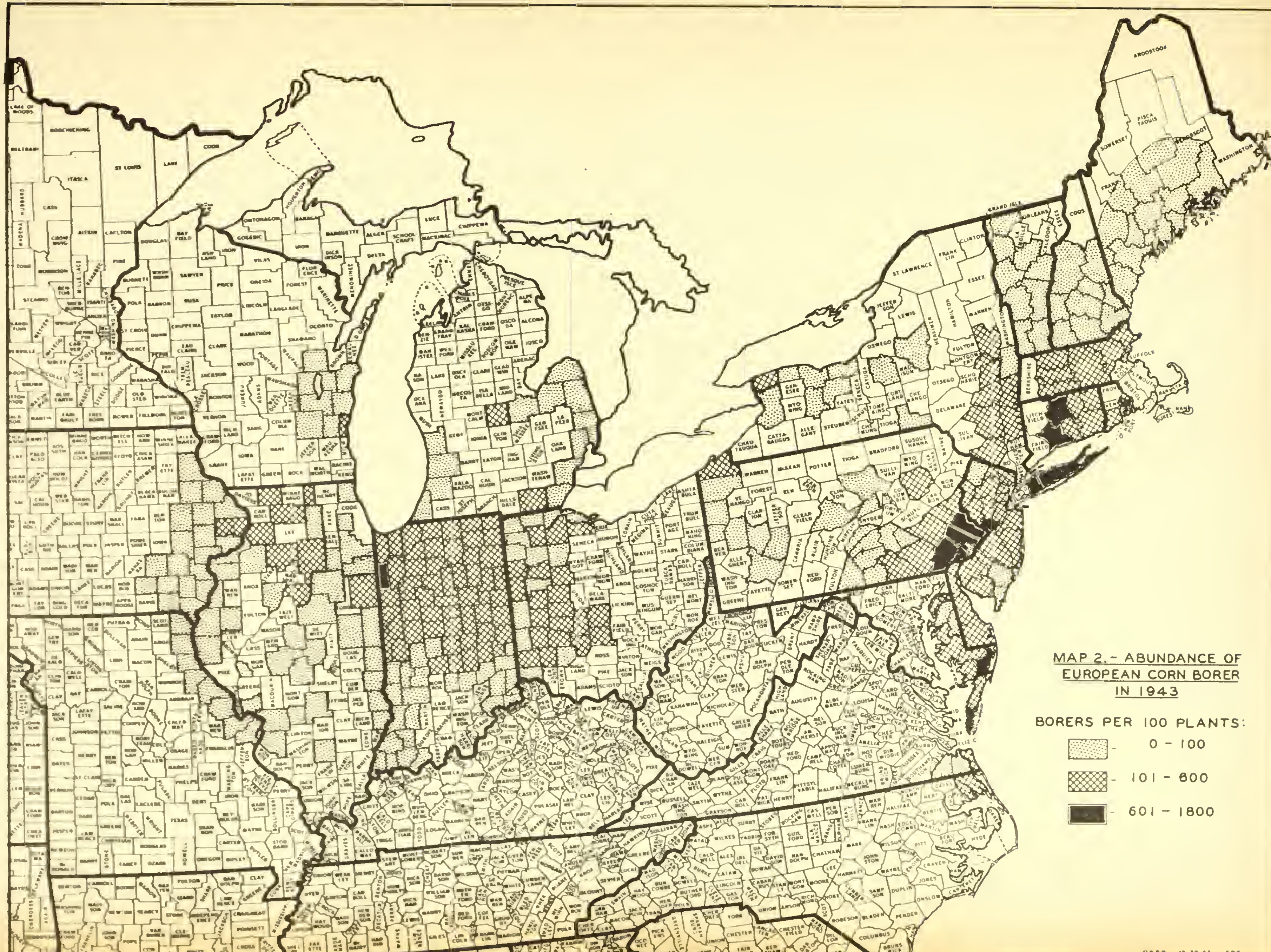
Table 2.--European corn borer abundance in corn, fall of 1943, and comparisons with data for 1942--Continued

State and county	Average borers per 100 plants 1942	1943	State and county	Average borers per 100 plants 1942	1943
	Number	Number		Number	Number
Pennsylvania (Cont'd)			Virginia:		
Dauphin	-	100.4	Accomac	223.6	569.0
Delaware	261.4	1267.0	Nansemond	43.2	50.2
Erie	51.0	292.8	Norfolk	23.0	34.4
Franklin	-	11.6	Northampton	236.4	1389.0
Indiana	2.4	8.4	Princess Anne	420.0	206.4
Juniata	-	15.2	Average:		
Lancaster	44.2	438.4	5 counties	189.2	449.8
Lawrence	-	2.3			
Lebanon	3.2	100.0	Wisconsin:		
Lehigh	118.2	227.8	Calumet	25.6	60.6
Luzerne	-	131.6	Dodge	15.6	15.0
Lycoming	-	14.2	Fond du Lac	19.0	88.0
Mercer	-	48.3	Manitowoc	30.6	37.0
Montgomery	371.6	998.4	Outagamie	11.2	74.6
Northampton	173.0	262.8	Ozaukee	38.6	141.4
Perry	2.8	29.6	Sheboygan	71.8	92.2
Union	-	33.6	Washington	13.2	32.0
Westmoreland	.0	0.	Winnebago	21.8	13.8
York	145.0	125.5	Average:		
Average:			9 counties	27.5	61.6
18 counties	96.2	367.6			
28 counties	-	251.7			
Rhode Island:					
Bristol-Newport	84.4	498.4			
Washington	74.2	298.2			
Average:					
2 counties	79.3	398.3			
Vermont:					
Addison	20.2	3.8			
Bennington	90.9	43.3			
Chittenden	5.8	19.4			
Franklin	12.6	11.6			
Grand Isle	14.2	12.0			
Orange	8.4	13.8			
Rutland	20.6	27.4			
Washington	9.4	17.4			
Windham	25.6	70.0			
Windsor	11.2	29.8			
Average:					
10 counties	21.9	24.9			

Table 3.--European corn borer abundance in early sweet corn, summers of 1942 and 1943

State and county	Locality	1942 Fields	1942 Average borers per plant	1943 Fields	1943 Average borers per plant
		Number	Number	Number	Number
Connecticut:					
New Haven	New Haven	25	7.9	15	9.5
Illinois:					
Kankakee	St. Anne	8	12.3	4	38.3
Madison	St. Louis	-	-	10	0.1
Maine:					
York	-	-	-	25	0.5
Michigan:					
Monroe	Erie	5	6.7	1	14.6
New Jersey:					
Burlington	Beverly	25	4.0	20	9.9
New York:					
Albany	Albany	-	-	4	10.8
Columbia	-	-	-	8	7.2
Monroe	Rochester	3	3.5	2	1.8
Nassau	-	-	-	11	0.8
Onondaga	Syracuse	10	5.7	10	6.5
Ontario	-	-	-	5	2.8
Rensselaer	Rensselaer	-	-	1	2.1
Ulster	-	-	-	5	4.4
Ohio:					
Lucas	Toledo	20	8.5	6	36.3


MAP I.-KNOWN DISTRIBUTION OF EUROPEAN CORN BORER IN 1943
-KNOWN INFESTED AREA IN 1942
-ADDITIONAL COUNTIES FOUND INFESTED IN 1943
B.E.P.Q. 12-30-43 SDC


MAP 2.- ABUNDANCE OF
EUROPEAN CORN BORER
IN 1943
BORERS PER 100 PLANTS:
- 0 - 100
- 101 - 600
- 601 - 1800
BEPQ 12-30-43 SDC

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

INSECT PEST SURVEY

Special Supplement December 30, 1943

The Migration and the Abundance of the Screwworm in 1943.

By W. E. Dove, In Charge
Division of Insects Affecting Man and Animals

Early shipments of cattle made from the drought-stricken areas of the Southwest to northern grazing areas, resulted in the spread of the screwworm (Cochliomyia americana C. & P.) to some areas never before infested. The insect also spread in the southeastern part of the country by natural migration and through shipments of cattle from Florida, where it also passes the winter. A survey was conducted in 26 states between June 15 and November 30, in order to locate the infestations, determine incidence and predisposing causes, and for the purpose of enabling stockmen and interested agencies to cope with the situation. The timely information furnished to them included the use of Smear 62* as a treatment and preventive for screwworm, details concerning infestations, and the sources of materials needed for control of the pest. The occurrence and relative abundance of screwworms during the season are shown on the accompanying map. Where cases were found to be less than 2.0 percent of the animals, they are represented as of medium occurrence. Those of 2.0 percent or more were considered as serious, and are indicated as heavy infestations.

ALABAMA.— The natural migration of flies moved from western Florida and southwestern Georgia to most of the southern third of Alabama. In general, the infestation was light, although it was heavy in Lee, Macon, and Montgomery Counties, where several carloads of infested cattle were received from Florida. In the center of the infested area, there are 3 counties in which no specimens of the insect were found. Cotton is chiefly grown in these counties, livestock being comparatively scarce. The southern two-thirds of the State was surveyed.

*W. E. Dove, U. S. D. A. Leaf. 162, rev. 1943.

ARIZONA.— Rains and flash floods in some areas of the State no doubt were the cause of more screwworm trouble. In the southern part there was a considerable increase in myiasis, the incidence running as high as 2 percent in one or more classes of animals in some local areas. The infestations during August were much heavier than early in June.

ARKANSAS.— From observations it appeared that the migration moved eastward toward the southwestern corner of Tennessee and the northwestern corner of Mississippi until the whole State was lightly infested.

CALIFORNIA.— In August light and scattered infestations did not extend beyond Imperial, San Diego, Orange, Riverside, and San Bernardino Counties. During mid-September somewhat heavier infestation showed up in the southern part of the State, particularly the southern half of Orange County. By the end of the season infestation occurred as far north as the San Joaquin Valley. Scouting was very thorough and extended a short distance north of the infested territory.

COLORADO.— Late in August infestations were found in the southeastern part of Colorado from the Kansas line as far west as Saguache, Rio Grande, and Almosa Counties. Cases were light, except on some ranches where late docking of lambs in June and July caused considerable local trouble. The livestock owners agreed that their most troublesome screwworm season occurs from September 1 until cold weather; however, an exception was made by stockmen in the San Luis Valley, who stated that the greatest number of cases occurred in June, July, and August, when the daily temperature ranges from about 80 to 90° F. In September infestation extended to almost exactly half of the State, and nearly all of the counties lying east of a line from the northeastern to the southwestern corner of the State. The infestation diminished to the westward, being very light along the western boundary of the infested part in the State. In the high altitudes the screwworm cases occurred before cool weather. The survey covered the State except the northwestern corner.

FLORIDA.— The peninsula of Florida is an overwintering area and a source of screwworms for the entire Southeast. Activity started unusually early in the spring and a heavy population had built up before the initiation of the survey in June. This was followed by a spread of the pest to adjacent areas.

Most of the infestations were predisposed by the Gulf Coast tick, castrations or other man-made injuries, and by injuries that result from the birth of young animals. Many stockmen and county agents reported that the infestation was the heaviest in 4 or 5 years and that it was aided by climatic conditions and an abundance of livestock wounds. The spring and summer of 1943 were abnormally dry and there was more opportunity for flies to complete their development than during rainy seasons when the lowlands are flooded and the immature stages are drowned. Owing to the shortage of manpower, many infested animals were not treated and there are large numbers of cattle and hogs that roam the woods, untended and seldom seen by the owners. A heavy infestation was expected in most of these counties in western Florida as soon as the hogs were turned into the peanut fields. This expectation was based upon the usual practice of ear-marking and castrating hogs when they are turned into the peanut fields, and by hog bites due to fighting. Owing to activity of our scouts and in making Smear 62 available, the expected build-up in population was prevented. Four cases of screwworms in man were reported, but only three were verified. Two of these occurred in the nostril and one was in a chicken pox lesion on the back of the neck of a little girl.

GEORGIA.—Many of the stockmen are of the opinion that the screwworm appeared from 6 weeks or 2 months earlier than in any previous year. The insect was widespread in the southern three-fourths of the State and particularly heavy in southern counties where large herds of cattle graze in the woodlands. The infestations were predisposed by bites of the Gulf Coast tick, by man-made wounds such as castration, dehorning and earmarking, and by injuries resulting from the birth of young. In Jasper and Jones counties heavy infestations were reported in cattle that were shipped into that area by inexperienced stockmen. All of the State except the northern one-fourth was surveyed.

ILLINOIS.—In September infestations were found in 9 counties being particularly severe in Bond county where about 10 percent or more of the animal population was involved. These cases undoubtedly started as a result of a shipment of about 4,000 head of southwestern Texas sheep into the state in June. No infestations were found in any of the southern counties along the Kentucky state line. In September fewer cases were found in Grundy, Henry, Knox, McLean, Mercer, Peoria, and Warren counties; and in October the infestations had spread to Vermillion and Iroquois counties, both of which experienced considerable trouble. Not more than 1 percent of the animals however were involved.

INDIANA.— In the survey of the entire State only scattered moderate infestations were seen.

IOWA.— Infestations were reported in September in 24 counties, all of which were light and scattered, except in Appanoose, Lee, and Louisa, which seem to be quite generally but not heavily infested. In Humbolt County there was some loss among cattle, hogs, and sheep. In October practically the entire state of Iowa was involved but the infestation was very light and cases were hard to find in some counties.

KANSAS.— The infestation was comparatively light, the heaviest infestations occurring in the northern part of the State around Topeka in 7 or 8 counties that are heavily stocked with cattle.

KENTUCKY.— No infestations were found in the 9 counties visited in the western part of Kentucky but one doubtful outbreak was reported from Calloway County. Early in June 60 lambs were castrated and docked and on the following day a veterinarian found infestations of what he considered to be screwworm. No other infestations were reported on this farm or from any adjoining farms.

LOUISIANA.— Screwworms were found in all parishes bordering the Mississippi River, except possibly St. Tammany Parish, which lies directly north of New Orleans. Since Washington Parish on the north and Tangipahoa Parish on the west of St. Tammany were infested there is reason to believe that St. Tammany was also involved. The entire state was infested with the possible exception of a few parishes south of New Orleans. Screwworm incidence was light and somewhat scattered in the lower half of the state, but in the northern half the infestations were quite abundant, approaching 2 percent of the animals in some counties, even along the Mississippi state line.

MICHIGAN.— The lower half of the southern peninsula was inspected but no infestation was found.

MISSISSIPPI.— A careful survey in the entire State revealed only a few scattered infestations in 8 of the 82 counties. The cases occurring in Lauderdale and Clark counties were probably the result of the natural migration from Alabama. The others seemed to have been due to the importation of infested livestock. A number of infestations were reported along the Mississippi River and were found to be blowfly maggots. They occurred in recently dehorned cattle, in old castration wounds, and in two instances in the hooves of horses.

MINNESOTA.— A limited survey in the southern part of the state showed infestation in 12 counties. The counties of Winona, Houston, Fillmore, Mower, and Freeborn were surveyed but no infestation found. No survey was carried on north of the area indicated on the map as infested.

MISSOURI.— Screwworms were found in every county bordering the Mississippi River, except Scott in the extreme southeastern part of the state, but since Mississippi County, just south of Scott, and Cape Girardeau on the north were both infested, it is almost certain that Scott was also. There was very little trouble in southern Missouri and the scout did not find a county that ran as much as one-half of 1 percent infestation and in most of the counties the cases were scattered. All reports from livestock growers indicated that from the latter part of September until November the screwworm season is at its worst.

NEBRASKA.—Rather general, light infestations were found, but they were distinctly spotted and confined to local areas that had received shipments of southern animals. The survey covered the southern and eastern parts of the state confined by a line drawn from Knox to Duel county.

NEVADA.— The southern half of the State was surveyed. Moderate infestations were found in the southeastern part only.

OHIO.— Preble and Darke were the only counties inspected but neither was infested.

OKLAHOMA.—Heavy infestations were reported from as far east as central Oklahoma. North of the Creek County; namely, in the Osage grazing area in Oklahoma, which is heavily stocked with cattle, infestations were generally about 1 percent of the livestock population.

SOUTH CAROLINA.--Infestations were found in Beaufort County and doubtful cases were reported in Colleton, Orangeburg, Saluda, and McCormick counties. The southwestern one-fourth of the state was surveyed.

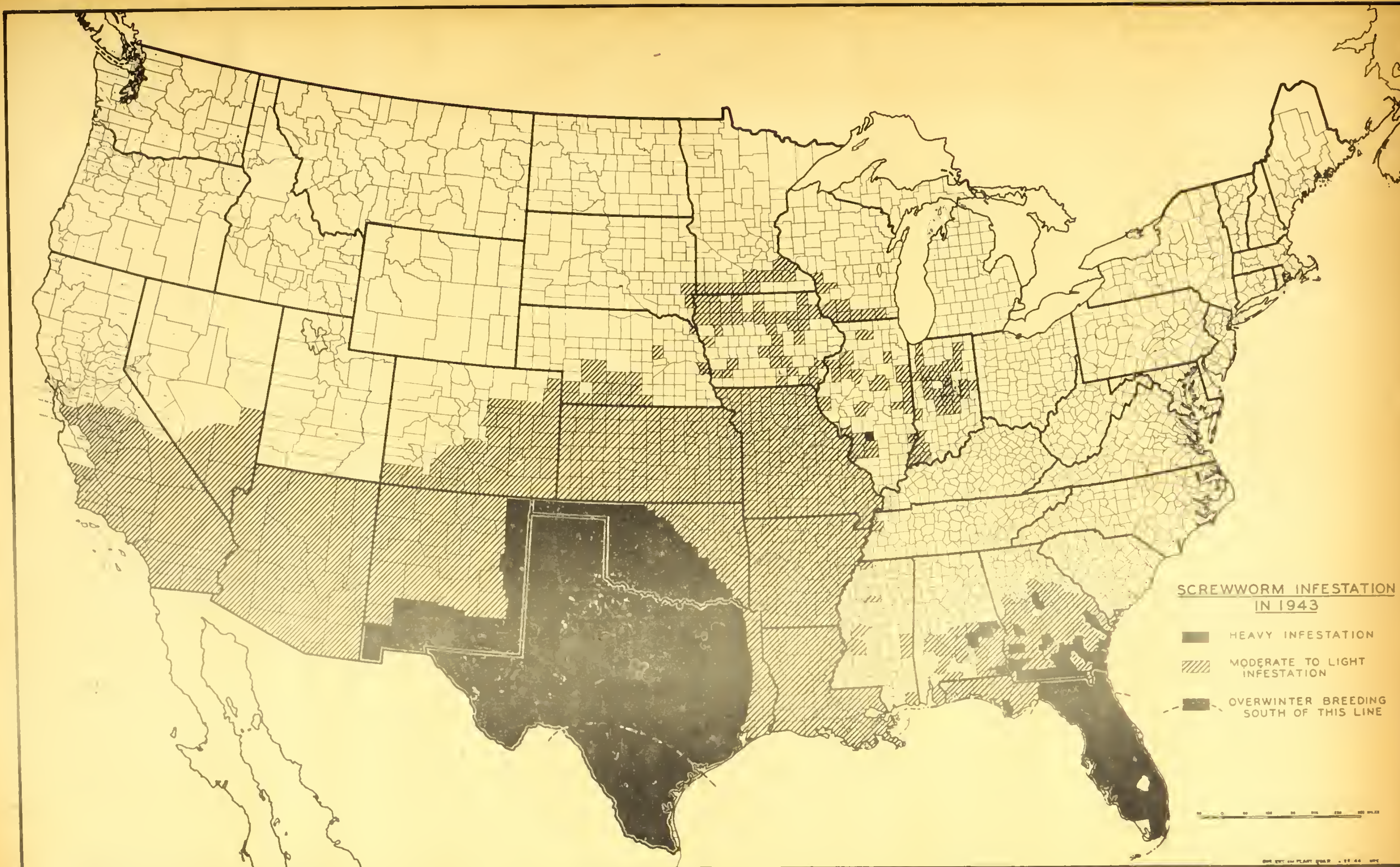
SOUTH DAKOTA.--Light infestations were seen in only 2 counties, Minnehaha and Lincoln; 5 additional counties, Hutchinson, Turner, Yankton, Clay, and Union counties were surveyed.

TENNESSEE.--The survey was conducted in 18 western counties, Dyer being the only one found infested. One doubtful case was reported in each of the following counties: Obion, Shelby, Haywood, and Madison. A number of other infestations were reported, but were found to be blowfly maggots.

TEXAS.--In Texas over 50 county agents sent in tabulated reports on the situation in their counties. These reports came from all parts of the state, as far south as Starr County in the lower Rio Grande Valley, as far north as the Texas Panhandle, and eastward to Rains County in northeastern Texas. The infestation was heavy (above 2 percent), but owing to the continued hot, dry weather the infestation was reported to be lighter in August than earlier. By mid-September the screwworm incidence in the heavily-infested area had been reduced considerably, with the exception of two areas, one of which lies in the southernmost part of the state and the other just east of Lubbock and Amarillo in the Panhandle. County agents in these districts reported infestations of from 2 to 10 percent in all classes of animals. At this time a few counties in the western part of the state, northwest of the San Angelo country, also reported rather heavy infestations in shear cuts of goats, and in eastern Texas only two counties, Rains and Smith, continued to report heavy infestations. During October the infestations dropped considerably and most of the county agents reported only light infestations. Starr County in the extreme southern part of the state, however, reported from 1 to 8 percent infestation.

UTAH.--The southern half of the State was surveyed and no infestations found.

WISCONSIN.--In the inspection of the southwestern part of the State, several counties were found infested.



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